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ABSTRACT

The program is a terminal course in chemistry for 9-12 grade students who are non-science majors, low achievers, and/or American Indians. Its objectives include to provide a systematic and practical overview of the discipline of chemistry; to change student behavior through this knowledge; to develop social responsibility, scientific attitude, and the ability to apply what is learned to community situations; and to demonstrate knowledge about the great scientists, including the contributions made by American Indians. The units cover: our chemical world--the chemist's work, the world around us, contributions of scientists; fundamentals of chemistry--symbol and valence, atomic structure, mole concept, acids, bases, salt; environmental chemistry--air and water pollution and purification; chemistry in home and in farming; psychic drugs; chemistry and medical technology; space explorations; and, chemistry is fun--Christmas and Easter demonstrations, a chemical fair, chemistry and the national economy. Each unit first describes content, references, and objectives. The text of the units appears under four column headings: (1) Content, e.g., use of bleach; (2) Examples, Apparatus and Materials, e.g., drinking water, beaker, bleach; (3) Activities, e.g., students purify the water by adding bleach to it; and (4) Evaluation, e.g., students write a report on water purification methods used in their community. (Author/NQ)

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TURN ON CHEMISTRY PROGRAM

WITH A FOCUS

ON COMMUNITY VALUES

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PART A

I. INTRODUCTION

In the past chemistry has played an important role in life. Today, especially in the fields of health, transportation and industry, it is changing our life. A close partnership exists between chemistry and the economic, social, educational and political issues of our times. Let me give you an example with world wide ramifications. Before 1960 both the Soviet Union and the United States had deployed only liquid fuel rockets with a minimum of four hour fueling time. Because there could never be enough warning time to launch these rockets before they were destroyed on the ground, each side felt that their opponent could use these weapons in a surprise attack only. This, of course, increased international tension. With the development of solid fuel rockets having only a 32 second firing time this instability in the world was reduced. Now neither side could hope to destroy the other's rocket on the ground. Because the suicidal nature of a rocket attack was evident, tension between the Soviet Union and the United States was reduced to a controllable level. We are living in an atomic and space age where students are bound to be concerned with some fundamentals of chemistry and their applications in every day living. This applies not only to students but to all youth living in the home, in the community and in the school. Chemical knowledge which can help in these syndromes does exist. The vast chemical knowledge of man that now exists is available in books and the publications. There are numerous chemical magazines and journals reporting research now being conducted in various parts of the world. But an avalanche in chemical knowledge has thundered down upon man in the last 20 years.[1]

The teacher of chemistry in a school must be aware of the subject matter which he must teach within the prescribed year. There are so many problems which a chemistry teacher must face. For example:

> How does he include all the knowledge, resulting from this explosion, in chemical knowledge, within the text books?
>
> What is today's student in high school chemistry supposed to learn?
>
> What are they actually learning?

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[1] R.M. Kalra, "The Chemistry Teacher in a Developing Country", Journal of Canadian Chemical Education, Ottawa, October 1969, pp3-9

What does the study of chemistry contribute to secondary students' educational developments besides facts, concepts and generalizations?

Any skills? Any Values?

The answers to the above questions depend upon the existing curriculum. CHEM study and CBA are the new alphabets of American Science Education. These projects received massive support from National Science Foundation for the improvement of Chemistry Curriculum. In these new alphabets, ability to think inductively became the built-in goal.

In the opinion of this writer, these new programs in Chemistry, especially CHEM study which is being caught in our schools, have been quite effective and successful for 35% of students. But most of the chemistry teachers are aware that the remaining 65% of the students who are mostly non-Science (or Chemistry) major students and low achievers are consistently disinterested in chemistry and the lack of interest often results in failure in the subject. Because the CHEM study (present course content as it now exists) presents a world which is alien to the above students, this disinterest should not come as a surprise.

It is quite obvious that the students interest is aroused only when he perceives something of value in the subject or sees a practical application of knowledge to be gained. To sum up, it is most unfortunate to point out that very little effort is being made to arouse interest in chemistry for remaining 65% of the students who are comprised of non-science major, low achievers and usually a few North American Indian students and Afro-American students.

In order to arouse interest in chemistry for the above students, the writer in this project has made an attempt to introduce another alphabet TOCP (Turn on Chemistry Program) in modern curriculum developments in Chemical Education.

TOCP (Turn on Chemistry Program) is a terminal course in Chemistry for the students who are non-science major and low achievers. The content in this course is arranged so that students may gain a better understanding of the part chemistry plays in their every day life and learn about its application to the

daily life, the local community and to industry. The writer also incorporates some of the scientific achievements of the North American Indian people and Afro-American students and tries to correlate the resulting information with some of the Chemical concepts taught in schools. Hopefully, Native Indian students and Afro- American students may develop pride in their scientifically rich heritage, develop an interest in learning to understand the world in which they live through an understanding of Chemistry, and consequently achieve satisfaction from success.

II. PHILOSOPHY OF TOCP (Turn on Chemistry Program)

A philosophy of chemistry teaching consists of aims and objectives of teaching in general and of chemistry teaching in particular. In order for a chemistry teacher to impart meaningful chemical education to high school students, a background in educational philosophy in general is needed. The objectives are derived from the philosophy. The objectives of Chemistry teaching may be classified into categories which are different in scope. The kind of chemical education advocated for the non-science major high school students by this writer is categorized below:

The first aim of chemistry teaching in this program (Turn on Chemistry Program) is that the student shall demonstrate in the field a knowledge of the fundamentals of chemistry. The major objective of the discipline of chemistry has been,the discovery and contribution to new knowledge; the establishment of general principles or facts. Any new course must contain this historic objective as any current curriculum must build upon the past.

The proposed course is introductory in nature and should help to familiarize a student with the fundamentals of chemistry suiting the intellectual capacity, needs and interests of the students. In the opinion of this writer, the basic aim of chemistry teaching in the high schools must be to supply foundational knowledge of chemistry which may be brought into use in daily life through the study of applications in chemistry.

Thus, the main object of the designed course in chemistry is to provide a systematic and practical idea of the discipline of chemistry and to change student behaviour through this knowledge.

The second aim of chemistry teaching is the implementation of seven cardinal principles of education recognized in the U.S. which are (1) health (2) command of fundamental processes (3) worthy home membership (4) vocation (5) citizenship (6) worthy use of leisure, and (7) ethical character.[2] For instance, a unit on "Chemistry helps us to know our bodies" can minister to health, worthy membership, vocation, worthy use of leisure time and citizenship. It may minister to certain attitudes, interests, skills and understanding.

The third aim of chemistry teaching in the high schools in this program would be that students should demonstrate abilities which are the by-products of the knowledge. If the students have acquired scientific knowledge from the designed course, they consequently should develop abilities to behave scientifically.

In order to achieve the above aim that the students should behave scientifically, the designed course should inculcate the following scientific habits which students would be asked to demonstrate:

(a) Reliance on Facts
(b) The Power of Observation
(c) The ability to Evaluate, Generalize & to Locate Problems
(d) The Ability to Use the Scientific Instruments Common to the Laboratory

The fourth object of chemistry teaching is to demonstrate the ability to apply what is learned to practical situations in the community for the improvement of life.

An important aim of chemistry teaching in the high schools is to make the students better and alert citizens who can improve the community life. In order to achieve this aim, the course content in chemistry should have practical applications to diily life. In farming and hygiene, for example, teaching of chemistry can be related to the problem of purifying water. The relationship of science instruction to the school's attempt to help every individual lead a worth while life is admirably stated by Brunson and Dowling.

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[2]Commission on the Reorganization of Secondary Education, Cardinal Principles of Secondary Education, U.S. Bureau of Education, Bulletin 35, Government printing office, Washington, D.C., 1918 - p.30

> A responsibility of the school is to help every individual to lead a worth while life. Those situations which can be better met by an understanding of the basic concept of science become forts of science instruction. Physical and mental helath which are affected by sleep, rest, fatigue, diet, exercise, posture, and drugs can be assumed for the pupil. Self assurance, which comes from a sense of achievement and understanding of normal variability, is necessary to the best adjustment and can be built by the study of chemistry. Through an understanding of organic and inorganic changes, the pupil aims appreciations which help him to see himself in his proper place with relation to the world about him. By constant practice in recognizing problems, seeking evidence to be weighed and arriving at the conclusions, the Scientific method becomes a basis for action with the pupil. Science can help present certain fundamental principles which should be understood through partaking in and preparing for homemaking.3

It will be the goal of this curriculum to implement these ideas.

The fifth objective of teaching chemistry in the high schools is that the students shall demonstrate the development of scientific attitudes.

The development of a scientific attitude could be demonstrated as the ability to do the following:

1. To observe and discuss facts objectively
2. To be open minded and not to be superstitious
3. To review and revise one's opinion as the evidence warrants
4. To think inductively

Success in developing scientific attitudes depends mostly upon the teacher, and it is important that the science teacher keeps always in mind that students develop attitudes more from examples than from abstract percepts. Some students may have certain beliefs in superstitions, diet, drugs, astrology, patent medicine, self doctoring and the like that should be dealt with when the pupils reveal them.

A vitalized study of science with its emphasis on open mindedness, tolerance and objectivity would inevitably lead to the development of a more secular out-look, in the sense in which we use the word, amongst those who profess different religions.

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[3] Brunson and Dowling, Suggestions for the Teaching of Science in Twelve Year Program (South Carolina: Department of Education Publication) p. 47

The sixth aim of Chemistry teaching in this program is that the student shall demonstrate knowledge concerning the lives of the great scientists of the world and especially of their country.

In the opinion of this writer, an important thing a Chemistry teacher may do in the high schools is to develop pride in the Scientific culture and contributions made by culturally different people. It is necessary for a science teacher to believe basically in the competence of their scientists. The teacher must stress their achievements in science in a class so that students may develop confidence in their scientists and consequently in themselves.

To summarize, a philosophy of this terminal Chemistry program is based on a new system of chemical education that will enable high school students to develop skills and acquire knowledge which will produce a better way of life for them, and which will make it possible to lead the students to the discovery of knowledge. Thus, the primary aim of chemistry teaching is to serve the future i.e., to provide the students with knowledge as a fuel. To achieve this goal, curriculum and teaching methods in Chemistry need to be revised.

III. Bases on Which TOCP (Turn on Chemistry Program) is to be designed.

To understand adequately the role of chemical education in the community, it is necessary to ask the following question.

What are the major problems of the community which chemistry should prepare the children to tackle intelligently and purposefully?

In the first place, a town is a community where all people work, or at least under socially healthy conditions all should work. And this work is practical. For example, the community has many problems of sanitations and water pollution, health and hygiene. This implies the designing of a curriculum, particularly in Chemistry, which is closely related to the real problem of the community life and which is so presented that the conventional gap between school knowledge and life situations disappears. Thus, a curriculum should be developed which relates the teaching of various subjects to community life. For example, teaching of chemistry can be related to the problems of pollution, drugs and other problems relating to the daily lives of the students.

In the opinion of this writer, if the chemistry curriculum remains as bookish as it is at present, if in the organization of its time table and teaching methods and discipline it does not allow for the special needs and problems of the locality, it will fail to obtain the sympathy and the support of the people. The first problem is to transform schools into miniature communities where the child learns through applying knowledge. In order to achieve this aim, the curriculum in chemistry should be based on the needs of the community.

The next problem is to bring the school out of its isolation and connect it originally with all the worthy aspects of community life. This involves the utilization in school of the child's outside experiences, the basing of his studies on and integrating them with the knowledge and information and interests he brings with him to school. A chemistry teacher can do much towards the betterment of community life and, incidentally, the establishment of his own position and prestige in the community. It is not merely the teacher who has to make himself the center of community life and a radiating source of light and learning, but it is the school as a whole that has to assume this position. It is the purpose of this curriculum to serve these ends. The advantages of such an educational approach are obvious. The school becomes the center of community life. The tax payers feel that they are really getting a return of their money and they become actually interested in the welfare of the school.

Thus, the curriculum in chemistry should be based on the needs of the community. The second factor to be taken into consideration while designing the curriculum is the need of adolescents in economic relationships consistent with community structure. In order to achieve the above aim, the designed curriculum should also be vocational in nature, and this might be a terminal course which may help students to get a job.

The third factor to be taken into consideration is the educational level of the students. The designed curriculum would be based on the previous science education which students received in the earlier classes.

The fourth factor for curriculum design is the availability of the materials, library and laboratory tools. The designed curriculum should emphasize the utilization of local resources in the community.

The fifth and the last factor for curriculum design is the knowledge of the basic concepts in the discipline of chemistry. The designed curriculum should stress basic concepts in the discipline of chemistry so as to have a sound grounding in the field of chemistry. Unless the students have sound fundamentals of any knowledge, it is quite impossible to transform the knowledge in any other situation.

IV. Organization of the Turn on Chemistry Program (TOCP)

Listed below are some of the guiding principles which will be followed in the development of the above program:[4]

(1) The curriculum shall be organized into units each of which shall be realted to some significant aspect of the environment.

(2) The unit will be essentially a major problem of everyday life to which chemistry may contribute an intelligent basis for human adjustment.

(3) Each unit shall include only a few principles or generalizations of chemistry.

(4) The organization, in part at least, shall be in the form of problems or projects to insure education in problem solving, which is the nature of chemistry.

(5) There shall be relatively few units, in order to insure that pupils are brought to an understanding of the larger relationship of the facts and principles of chemistry rather than to the mere memorizing or detailed facts.

(6) The distribution of time and emphasis to the various units shall be determined by the total functional social value of the units, its "teachability" and "learnability", the teachers' and pupils' interest in the unit, the local significance of the unit, and its value to other units of the course.

(7) The laboratory work shall be included as an integral part of the problem solving and shall, therefore, have the characteristics of experience and should de-emphasize illustrative or conformatory work.

(8) The organization of the course shall be such that it will lead to the attainment of the immediate and ultimate objectives.

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[4] National Society for the Study of Education: Thirty-first year book, Part I, Bloomington, Illinois: Public School Publishing Co., 1932, p. 209

COURSE CONTENT IN TURN ON CHEMISTRY PROGRAM (TOCP)

The writer has made an attempt to construct a curriculum in chemistry for high school students who are non science major, low achievers or disinterested students by taking into consideration the various factors which have been discussed earlier under philosophy of this program.

The writer has expanded one single unit which is ready for use by the teacher and a series of suggested unit outlines which, it is hoped, individual teachers might themselves expand following the pattern of the original complete unit.

The following designed course is organized, therefore, into units, each of which will relate to some significant aspect of local environment; one unit being complete as a pattern for the teacher, the others being in suggested outline form.

The organization is in the form of problems and the laboratory work is included as an integral part of the problem solving. Rushing through a predetermined mass of material in order to "cover the course" must be avoided. Quality of work should be given more consideration than quantity.

Suggested Content of the Turn on Chemistry Program SECTION A

UNIT I - Our Chemical World (Expanded Unit)- suggested time: 25-[illegible] hrs.

CONTENT

A. The work of the chemist

B. The world around us

C. Contributions of North American Scientists (Native Indians and Afro-Americans included) to the Scientific literature.

UNIT II - Fundamentals of Chemistry - suggested time: 20-25 hrs.

CONTENT

A. Symbol and valence, element mixture and compound

B. Atomic structure and Mole Concept

C. Formula, acids, bases and salt

ENVIRONMENTAL CHEMISTRY SECTION B

UNIT III - Chemistry Helps us to use water and air safely and to conserve it.
Suggested time: 20 - 25 hrs.

CONTENT

A. Three states of water
B. The world's water and natural sources of water
C. Importance of water in our daily lives
D. Water Pollution
F. Methods of purification of water
F. Composition of water
G. Air pollution

UNIT IV - Chemistry in Home and in Farming
Suggested time: 25 - 30 hrs.

CONTENT

A. Chemistry of building material
B. Soil and Fertilizers
C. Importance of Chemistry in Keeping your Farm Productive

UNIV V - Psychic Drugs and You
Suggested time: 20 - 25 hrs.

CONTENT

A. Major categories of drugs
B. Medicinal uses and abuses of
1) tranquilizers
2) narcotics
3) hallucinogens
4) stimulants
5) sedatives
6) miscellaneous
C. Suggested activities regarding drug education

UNIT VI - Chemistry and its applications in Medical Technology

A. Importance of Chemistry in the field of Medical Laboratory Technology

B. Major branches of Medical Laboratory Technology

C. Methods of Measuring Specific Gravity, pH & Protein of Urine

D. Methods of testing for Glucose & Ketone

UNIT VII - Space Explorations (suggested time: 10-15 hrs.)

Content

A. Solar System

B. Apollo Flights

C. Canadian Space Program

UNIT VIII- Chemistry is Fun

A. Christmas and Easter Demonstrations

B. Role of Chemistry in the National Economy of a Country

C. Chemical Fair

PART B

11a

UNIT I

OUR CHEMICAL WORLD

(suggested time: 25-30 hrs.)

I. Overview

The writer of this program has treated only this unit extensively, as an example of how the chemistry curriculum should be constructed. This unit utilizes only the materials the teacher can secure and is designed to provide useful chemical learning for the high school students who are non science major, low achievers or chemistry disinterested students.

The units which follow Unit I are, therefore, to be construed as an outline with some directions for the teacher to be expanded by following the pattern of this unit.

II Content

A. The work of the Chemist

B. The world around us

C. The contribution of North American Scientists (native Indian and Afro-Americans included) to the Scientific literature.

III References

Arthur G. Hoff, Secondary School Science Teaching (Toronto: The Blackston Company, 1961.)

Board of Education of the City of New York. Applied Chemistry for High Schools (New York: Board of Education of the City of New York, 1959)

George C. Pimentel (Ed.), Chemistry an Experimental Science (San Francisco; W.H. Freeman & Company, 1965)

Louis Haber, Black Pioneers of Science and Invention, (New York: Harcourt, Brace and World, 1970)

Unesco Source Book for Science Teaching (Paris: United Nationsl Educational & Scientific publication, 1966)

Victor C. Smith and B.B. Vance, Science for Every Day Use (Chicago: L.B. Lippincot Company, 1951)

STATEMENT OF GENERAL OBJECTIVES

I. The student should demonstrate that he understands the work of the chemist.

II. The student should demonstrate that he understands how the work of the chemist affects him, his family and the community.

III. The student should demonstrate that he is familiar with the methods and tools of the chemist.

IV. The student should demonstrate that he is familiar with his heritage in the area of Chemistry and related sciences.

Specific Objectives

The student should demonstrate that he understands the work of the chemist:

(A) in industry
(b) in the area of consumer goods
(C) in protecting the environment
(D) in agriculture
(E) extending the range of human knowledge
(F) protecting human and animal life
(G) in the analysis of Chemical substances

Suggestions to the Teacher in Implementing Objective I

The successful teaching of this course or any course depends on the abilities and resourcefulness of the Science teacher.

The purpose of the teaching suggestions is not to lay down hard and fast rules for the achievement of the above objective but to act as a guide. Thus, the science teacher should feel free to use any material which is not listed in this unit in order to make the students understand the work of the chemist.

However, the following suggestions should be helpful to the science teacher in order to accomplish the above objective.

(1) The teacher should make use of all local community resources (e.g. local pharmicist, doctor, lab technician, etc.) to explain the work of the Chemist. For example, the students should be asked to bring some articles (table salt, baking powder, fertilizer) from their homes involving the applications of Chemistry and discuss these in the class. Field trips to the town should be arranged. Before the trip, the students hould be told to look for examples of applications of Chemistry to the daily life.

(2) The teacher should apply the 'discovery approach' in dealing with the work of Chemists. Rather than giving a lecture, it is more effective for the teacher to arrange a round table conference at which students discuss the role of chemists in developing home products.

(3) The answer to any question should not be made readily available to the students. The students should be encouraged to think and struggle with the question. If the question is very difficult, the teacher should help students find the solution.

(4) To do work of some quality in Chemistry or any subject is a responsibility of the teacher. If this is done, the threats of failure are not desirable. According to the writer's experience, such a threat of failure by the teacher has a negative effect upon the pupil. This threat has results in a dislike for the subject. Thus, the teachers should motivate pupils by making their teaching interesting and meaningful so that they will achieve desirable success. The teacher should complement the student when success is achieved.

(5) The list of companies and institutions which distribute on request useful free materials for science teaching is found in Appendix I, and the teacher should make wide use of this, as well as of any materials his ingenuity can concoct.

Content	Examples, Apparatus & Material	Activities	Evaluation
Problem I - A What is the work of the Chemist?	The following are some of the suggested local resources in the community. a) Agriculture Inspector b) Pharmacist c) Lab Technicians d) Educated persons of the community Some students may bring the fact that 30 years ago Tuberculosis used to be considered a fatal disease. Chemists discovered a medicine known as PAS (Para - aminosalicylic acid) and Tuberculosis (T.B.) is no longer considered a fatal disease.	Activity No. 1 Have the students investigate by inquiry at home and from local resources some articles made by Chemists of present - day use unknown 30 years ggo. Activity No. II The teacher should have a round table conference and lead a discussion about the information obtained by the students from Activity No. I. The teacher should discuss that many animals (cows, horses) became victim of diseases which were then incurable resulting in the death of the animal	The students will be evaluated corresponding to their participation in the round table conference.

Content	Examples, Apparatus and Materials	Activities	Evaluation
Problem I - A cont.		This was a great financial set back for a farmer, but most of the common diseases of animals which were once fatal can now be easily cured by modern medicines.	
	Veterinary Doctor	These medicines are often chemical compounds - synthesized by Chemists. If possible, a lecture from a veterinary doctor would be quite informative. The Teacher should also discuss the contributions of chemistry in textiles, vitamins, nutrients and insecticides.	
	Nylon Plastic Dyes D.D.T.	<u>Activity No. iii</u> Have the students study articles and products (e.g., nylon, plastic, dyes, D.D.T., etc.) made by chemists and discuss the work of chemists in the making of these products.	The students will be evaluated from their active participation in the class.

Content	Examples, Apparatus and Materials	Activities	Evaluation
Problem I - A Cont.		<u>Activity No. IV</u> Field Trip No. I: Arrange a field trip to a chemical factory near the community (if possible) and discuss the work of the Chemist. <u>Activity No. V</u> The teacher should arrange a visit to the local health unit. A member of the local health unit may be requested to speak on insecticides and chemicals used in water purification and sewage. Pharmacist can elaborate the work of the Chemist by giving some examples of modern medicines.	

Content	Examples, Apparatus and Material	Activities	Evaluation
Problem I-A cont.		After the visit to the local health unit, the teacher should discuss the role of Chemists in activities IV and V.	The students will be evaluated according to their participation in the discussion
		Activity No. VI The teacher can request some of the major petroleum companies (e.g. Texaco, Esso, Shell, Gulf Oil Co.) to show a film on the exploration and refining of crude oil emphasizing the work of the Chemist. If the film cannot be arranged the teacher can write to these organizations for pictures illustrating the refining of petroleum and the work of the Chemist	The students are asked to write a short report on the film, emphasizing the work of the chemist in the refining of petroleum.
		After the film showing, the teacher should have a round table conference and discuss the role of the Chemist in the petroleum industry	The students will be evaluated from their participation in the round table conference.

Content	Examples, Apparatus and Materials	Activities	Evaluation
Problem I-A Cont.	Distillation flask stand crude oil bunsen burner	<u>Demonstration</u> The teacher should carry out distillation of a mixture of crude oil which can be easily obtained from any gas station. <u>Activity No. VII</u> Have the students discuss each film and visit (Refer to Activity IV, V and VI), explaining the work of the Chemist in each of the above activities, thus reviewing the work of the Chemist in industry.	The students are required to record the observations in their laboratory note book and discuss the above observations in the class. The students are asked to submit a report on each film, emphasizing the work of the Chemist. The student should be able to list facts and concepts learned.

Content	Examples, Apparatus and Materials	Activities	Evaluation
Problem I - A cont.	80 grams of cotton seed oil 20 grams of lye Beaker (1000 ml) Water Thermometer Stirring rod Bunsen Burner	<u>Activity No. VIII</u> Demonstration I: Preparation of Soap Soap is made by boiling together either sodium or potassium hydroxide and some vegetable oil or animal fat (olive oil palm oil or cotton seed oil). Alkali + fat → soap + glycerine <u>Lab Instructions</u> Melt about 80 grams of cotton seed oil Dissolve 20 grams of lye in 40 ml of water. Pour the hot oil into the lye solution a little at a time stirring constantly and keeping the temperature below the boiling point. Heat for half an hour, then cool. Remove the cake of soap and test its action in water	

Content	Examples, Apparatus and Materials	Activities	Evaluation
Problem I - A cont.		Demonstration II: Preparation of tooth paste and powder Method I An inexpensive but effective tooth powder can be prepared by mixing 1 part by weight of powdered table salt and 2 parts of baking soda. The salt serves as an astringent and the bicarbonate reacts with food particles in the mouth. Method II Another powder can be made by mixing thoroughly 4 grams of powdered chalk, 1 gram of powdered sugar and 1 gram of Na_2CO_3	The students will be evaluated from the following question verbally. What ingredient is used in toothpaste for the purpose of a) Neutralizing mouth acids? b) Providing a pleasant after taste?
	Table Salt Baking Soda Beaker		
	Powdered Chalk Sugar Sodium Carbonate Beaker		

Content	Examples, Apparatus and Materials	Activities	Evaluation
Problem I-A cont.		Method III Toothpaste: Combine 125 grams of precipitated chalk $CaCO_3$, (available at drugstore at low cost), 95 grams of magnesium carbonate (a polishing material), 30 grams of powdered white soap. Mix these thoroughly so that the powders are well distributed. If a flavor is desired, add about 5 drops of peppermint. Add equal parts of glycerine and water to the powder until a paste of a familiar consistency results. Activity No. IX It is quite feasible to have a film show regarding the manufacture of consumer goods by requesting some of the major firms.	The students are asked to submit a short report giving the major ingredients and the methods of preparation of the following consumer goods: a) soap b) toothpaste

Content	Examples, Apparatus and Materials	Activities	Evaluation
Problem I - A		For example, Proctor Gambles, Lever Brothers have films about their products in daily use for publicity. The above activities demonstrate the work of the chemist in the area of consumer goods.	
The chemist helps make the soil more productive.	Agriculture Inspector	<u>Activity No. X</u> Invite an agriculture inspector to give a lecture on the Scientific farming which requires a knowledge of the Chemistry of soils and fertilizers. Some practical demonstrations. may be given by the speaker on the use of fertilizer.. The teacher should elaborate the contributions of the chemist in the manufacture of fertilizers.	

Content	Examples, Apparatus and Materials	Activities	Evaluation
	Two plants Fertilizer	Activity No, XI Have the students grow two plants under similar conditions, one with fertilizer and the other without fertilizer. Ask the students to submit a short report explaing the difference in the rate of growth of these plants. Tell the students the role of chemistry in extending the range of human knowledge.	The students will be evaluated from their reports explaining the role of fertilizer in growth of plants.

Content	Examples, Apparatus and Materials	Activities	Evaluation
Problem I - A		Chemistry has entered our daily lives that refer to chemical matters in newspapers and magazines and in conversation are common. The teacher should also emphasize cultural values of chemistry since a well educated person is one who has a general acquaintance with many fields of knowledge. The students should be able to understand what is written in chemical books, magazines and newspapers.	The students are asked to make a collection of clippings from their daily newspaper which deals with chemical research, chemical industries, or new chemical products. Students will be evaluated according to the number of clippings which deal with chemistry.
The chemist improves the quality of human and animal life.		Activity No. XII The teacher may show the films concerning the manufacture of drugs and their use in the protection of human and animal life.	The students are asked to write a report on the benefits of medicines in human and animal life.

Content	Examples, Apparatus and Materials	Activities	Evaluation
		The above films can be easily obtained from the pharmaceutical firms on request. After the film show, the teacher should arrange a round table conference and discuss the benefits of medicine in human and life.	
The chemist helps keep us healthy but also creates a problem of pollution. Problem I-A cont. NOTE: Students must show they understand one or more methods of purifying water and importance of same.		<u>Activity No. XIII</u> Demonstration III Distill some drinkable water with impurities and tell the students that there are various methods of purification of water. One of the most common used in the Chemical lab is distillation. Mention some of the methods of making water potable. For example Sedimentation, coagulation, filteration, aeration. Tell the students that these methods will be discussed in detail in Unit II.	The students are asked to submit a report on the following project and discuss it in the class. "How the chemist can help us in the portection of our environment." The students will be evaluated according to their participation in class

Content	Examples, Apparatus and Materials	Activities	Evaluation
		The teacher should also discuss water and air pollution around the community and the world by showing some pictures illustrating the problem of water and air pollution and how we can overcome the problem of pollution	
	Sulphur Carbon Bunsen Burner	<u>Demonstration</u> The teacher should demonstrate the problem of air pollution by the actual burning of sulphur and carbon resulting in the formation of SO_2 and CO_2. Tell the students that the problem of water pollution will be dealt with in detail in Unit II.	The students are asked to submit a report on the problem of air pollution in the community.

Content	Examples, Apparatus and Materials	Activities	Evaluation
Problem I-A cont. The chemist analyses the chemical substances.	Mercuric oxide Bunsen Burner Test tube	<u>Activity No. XIV</u> Heat mercuric oxide to illustrate analysis. Have the students state observations after the demonstration. The teacher should state the methods by which a chemist determines the composition of matter.	The students are required to write observations in their lab note books and discuss them in class.

Content	Examples, Apparatus and Materials	Activities	Evaluation
	Beaker Water Sulfuric Acid Electrodes Electric Source	Activity No. XV Pass an electric current through acidified water to illustrate chemical composition of water. Test the presence of hydrogen and oxygen by glowing splinter.	The students are required to write observations in their lab notebook and discuss their observations in the class
		Activity No. XVI Mix zinc and hydrochloric acid in a test tube. Test the presence of hydrogen by glowing splinter and evaporate zinc chloride solution.	Same as above

Evaluation of the first objective

In order to evaluate the first objective, as a whole, the teacher should evaluate each of the activities as suggested and grade the student according to the extent of his comprehension and appreciation of the work of the Chemist.

The following is a word of caution in assessing these criteria:

The teacher should make sure that the student has not merely memorized facts but understands the work of the chemist. Three simple methods for determining the student's ability are mentioned below.

1) Class participation in discussions and field trips, variety and quality of questions and his sincere effort to find a solution of the problem.
2) Reports
3) Oral Quiz

However, the following two activities might be helpful to the teacher in ascertaining that the students have understood the work of the chemist.

1) Have one group of students submit a report on industrial chemistry, a third group on agricultural chemistry, a fourth group on medicinal chemistry and a fifth group on extending the nature of human knowledge. Collect the reports, evaluate them and have students give a panel discussion in class. The purpose of this discussion is to allow students to pursue a field in which they have more interest, and present their findings to the class. After the discussion, each student should write a report on all the aspects of chemistry discussed, emphasizing the role of chemistry as it pertains to him.

2) Set out on a table some articles of daily use. Include some articles which do not involve any application of chemistry. Ask the students to point out those substances which are not developed by chemical processes.

OBJECTIVE II

The student should understand how the work of the chemist affects him, his family and the community.

Suggestions to the teacher in Implementing Objective II

1) The teacher should correlate content with the character of community life. For example, discuss how an understanding of chemistry will make a person a better farmer or a better citizen. The teacher should discuss the value of chemistry in all walks of life.

2) The teacher should use the investigation approach and encourage the students to participate in the discussion of the applications of chemistry in the daily life.

3) The teacher should not ridicule any question. Some questions may be irrelevant or ignorant. These should be directed in a constructive discussion.

Content	Examples, Apparatus and Materials	Activities	Evaluation
Problem I - B What is the world around us made of?	Rock Paper Cloth Water Fertilizers	<u>Activity No. XVII</u> a) Set out on a table all the equipment mentioned in the previous column and discuss the contributions of chemistry in the making of these substances. b) Have the students investigate and describe the applications of chemistry in the surroundings of their own town. Have the students eliminate those substances which are not developed by chemical processes.	The students prepare a list of the substances available at home involving the applications of chemistry and discuss in class.
Chemistry is important in our daily life.	Soap Cosmetics Disinfectant Fertilizers	<u>Activity No. XVIII</u> Ask students to describe what life would be without the following substances: soap, toothpowder, cosmetics, disinfectants. The teacher should discuss the many products	The students will be evaluated from their active participation in class.

Content	Examples, Apparatus and Materials	Activities	Evaluation
Problem I - B cont.		of a chemical nature which are used in the community life. Ask the students to solve the following problems by using materials that are the result of chemical technology: a) to remove spots and stains from the clothes. b) to extinguish fire c) to cure diseases like malaria, typhoid, flu.	
Chemistry helps in understanding our bodies.		The teacher should tell the students that eating is not only one of the most enjoyable activities but also one of the most essential activities for the body's development. The teacher should also explain the importance of a proper and balanced diet in the human body.	

Content	Examples, Apparatus and Materials	Activities	Evaluation
Problem I-B cont.		Provide a sample of a balanced diet. The teacher should also discuss the harmful effects of undesirable foods. Have the students discuss and make a report about the balanced diet which an average person should eat. Tell the students that the above activities on balanced diet would be discussed in detail in Unit V.	The students will be evaluated from their active participation in the discussion and a report about the balanced diet.
	Pictures of rats or persons showing unbalanced diet.	The teacher should exhibit the pictures of rats or persons eating in balanced diets, e.g. knock knees, bow legs, anemia.	

Evaluation of Objective II

In order to secure a reliable evaluation of the accomplishments of a pupil in this objective, it is necessary to make assessments of the component parts of a unit, such as the individual problems in this objective, as mentioned earlier.

The teacher should utilize all evaluation techniques mentioned previously. For example, the teacher should grade students according to the following criteria.

1) Participation in class discussion
2) Reports
3) Oral and written quiz

In addition to the above evaluation procedures, a subjective type of question may be used as the supplementary portion of an objective question. The following example would elucidate the above conviction.

Subjective Type of Question	Objective Type of Question
Write a short essay on the contributions of the chemist in the improvement of community life.	Please use ✔ for true and ✘ for false. Chemistry has specific applications in the following aspects of our life activities. a) Consumer goods b) Cleanliness (hygienic living) c) Reducing human sufferings

Furthermore, the teacher should give subjective types of questions in the form of problems where students learn to think.

The following question in the form of a problem would clarify the above statement:

PROBLEM I

It is said that the progress of a community depends upon the changes brought about by scientific discoveries.

Name a few scientific contributions involved in each of the following aspects of your life.

1) The home
2) Health
3) Agriculture
4) Communication

NOTE: Many different sets of answers are acceptable.

PROBLEM II

How can we use what we know of chemistry to improve our life?

The student should become familiar with the methods and tools of the chemist.

Suggestions to the Teacher in Implementing Objective III

1) The chemist employs an orderly method of thinking known as scientific method. In the opinion of this writer, Scientific method as a rote item in this program has little value, its value should be realized by actually applying it in classroom work (e.g. in experiments, demonstrations) and tell the students when scientific method is being used.

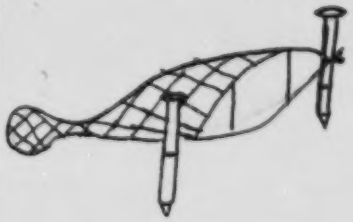
2) The teacher should show all the equipment present in the lab and explain the function of each item.

3) The teacher should advise the students to make clear and accurate records in their lab notebooks at the time of observations of what they have observed. The students should be sent into the lab to investigate the various scientific principles. Too much time should not be spent on getting the correct results which gives a false concept of the whole Scientific endeavor.

4) A resourceful teacher can overcome the problem of shortage of some laboratory equipment needed in this program to a certain extent by constructing various models in order to illustrate the various Scientific principles. For example, the teacher can make the model of a fire extinguisher. The students should be actively involved in the making of these models.

UNIT I - OUR CHEMICAL WORLD

Content	Examples, Apparatus and Materials	Activities	Evaluation
		Lab Activities Experiment No. I: Observation and Laboratory Method **Exercise I-A** How well do you observe? Have the students look around the classroom and laboratory. "List eight significant observations and compare your results with other students in your class."	The students are required to record the observations in their laboratory notebooks and discuss the observations in the class.
	In general, the following observations should be made: Chemical equipment present in the laboratory. Number of doors, windows and desks.		
	Candle Ruler (for measurement of length, height and diameter of the candle.) Tin lid Match box	**Exercise I-B** "What observations can be made on a burning candle?" The teacher should help the students in making observations and inference in the above experimentation.	Same as above

Content	Examples, Apparatus and Material	Activities	Evaluation
CONCEPT of observation, generalization and scientific attitude. Scientific knowledge of the habits of fish and other animals have been aptly described by Rev. Ernie Willie - a native Indian (during the author's interview) in the following paragraphs. <u>Scientific Knowledge of the habits of fish</u> (Rev. Ernie Willie) A net trap in the shape of a cone was hung between two posts (eight feet apart) driven into the river bed. As the small oopichen (candle fish)		Have the students define the concept of observation, generalization and scientific attitude in their own words from the exercise I-B discussed earlier. The teacher should also point out that the above concepts were utilized by so many people 100-200 years ago. For example, North American Indian's keeness of observation is displayed in his skill in fishing and hunting. Furthermore, Indian, keen naturalists know entire life histories of the animals how they hunted, their various stages of development and their seasonal movements. <u>Activity</u> If possible, invite a member from Indian community to explain the adjacent phenomenon of fishing. Also, arrange a class trip to the native Indian reserve to study their	The students are required to write the definitions of the concept of observation, generalization and scientific attitude in their note books. The students are evaluated according to their participation in the class discussion.

Content	Examples, Apparatus and Material	Activities	Evaluation
rested or slept, they drifted down streams into the traps which had been set at appropriate times. These fish were' desired not as food but as a source of oil. The loads of fish were dumped into open pits on the ground covered with cedar boughs and left for approximately two weeks. The decaying fish were then transferred into vats of boiling water. The oil was carefully skimmed and then filtered to give the purest fish oil. Other fish such as Salmon were caught with spears, nets or traps. Much of the fish caught was preserved by drying in order to provide a winter food stock. After the fish had been filled, they		fishing techniques. The teacher should emphasize an application of the concept of observation, generalization and scientific attitude in the native Indian fishing technique.	

Content	Examples, Apparatus and Material	Activities	Evaluation
were rocked and placed near the intense heat of burning alderwood in order to seal in flavour and dehydrate the flesh. The longer the dried fish was to be kept before eaten, the longer it was smoked. When the time came for the fish to be consumed, water was added and a nourishing meal resulted. The only difference between this food and contemporary dried foodstuffs is that the fish was not powdered and packaged. Illustration of the Extent of Native Indian Scientific Knowledge About Animals (rev. Ernie Willie) My people knew well the habits and characteristics of the animals and fish they hunted on land,			

Content	Examples, Apparatus and Material	Activities	Evaluation
sea and air. The Indians knew intimately; for example, the life cycle of seals. They knew how to locate the under-water entrance to their homes and how to discover their favorite feeding places. They knew the life cycles of animals and in what season the game was at its best to kill. The deer, for instance, is at its best just after it comes down from the hill country to the foot hills. It has had a great deal of mineral fed grass in the uplands, and because it is nearing the cold season it is firm and getting fat. In early fall, then, the deer is at its best. It was common knowledge that one does not hunt them in early		Have the students define the concept of observation, generalization and scientific attitude in their own words from the adjacent illustration.	The students are asked to write the definitions of the concept of obser-vation, generalization and scientific attitude in their note books with reference to the adjacent example.

Content	Examples, Apparatus and Material	Activities	Evaluation
spring or breeding season, for he might kill the doe while it is bearing or kill the buck when it is yet to perform. Winter is the best time to get ducks, not in the early spring.			
According to Sproat, the Nootka were well versed in local plants and know at just what time each plant should be gathered for medicinal properties. Oregon grape, for example, was known as the best tonic.		The above examples illustrate that their (Indians) interest in their invironment and their eagerness to experiment led to their discovery of the medicinal properties of many plants.	
Note: Tell the students that the contributions of Afro-American scientists will be discussed in detail in objective IV		The teacher should discuss the achievements made by Afro-American scientists such as Dr. Daniel Hale, Dr. George Washington Carver, Elijah McCoy. Tell the students that their observations have made excellent contributions in the field of science especially in chemistry.	Have the students write a short report on the contributions of Afro-American scientists.

UNIT I - OUR CHEMICAL WORLD

Content	Examples, Apparatus and Materials	Activities	Evaluation
Problem I-C: What is a physical change? Any change in matter which does not destroy the identity of a substance or change its characteristic properties is a physical change. It is a temporary change. Problem I-D: What is a Chemical change?	Ice Beaker Bunsen Burner Wood Bunsen Burner Test tube Zinc Hydrochloric Acid	Exercise I-C Demonstration: Melt ice and boil water to form steam. The teacher should tell the students that in the above example matter has undergone change. Its form may not be the same, but the matter has not lost its identity. Such a change is called a physical change. Exercise I-D Ask the students to observe a change in the following demonstrations and write it in their note books: a) Burn wood b) React zinc with dil. Hydrochloric acid in a test tube. Have the students tell the difference between this change and above change. (Refer to Ex. I-C.)	The students will be evaluated from their participation in the above demonstration.

Content	Examples, Apparatus and Materials	Activities	Evaluation
Problem I-D, cont. In a chemical change, new substance with new properties is formed.	Beaker (100 ml) Graduated Cylinder Conc. H_2SO_4 Potassium dichromate solution Ethanol Thermometer	The teacher should tell very clearly that in each of these changes the identity of the original substance or substances is lost. These are called chemical changes. Exercise I-E Demonstration: Preparation of chrome alum crystals. To 50 ml of water in a 100 ml beaker slowly add 5 ml of conc. H_2SO_4 with stirring rod. To the diluted acid, add 5 grams of $K_2Cr_2O_7$ and stir until dissolved.	The students will be evaluated from the following question: Which of the following are physical changes and chemical changes? a) The burning of coal b) The decay of food c) Freezing of water d) Burning of candle

Content	Examples, Apparatus and Materials	Activities	Evaluation
		Now slowly add 5 ml of ethanol to the solution while stirring carefully with a thermometer and leave the beaker for 1 - 2 weeks. Crystals of Chrome Alum will appear in the bottom of the beaker. Ask the students to write the observations in their note books explaining whether a change taken in the above demonstrations is a physical or a chemical change.	The students will be evaluated from their observations and their explanation about a change taken place in the demonstration in their notebook.

OBJECTIVE IV

The student should become familiar with the contributions made by various Scientists in the area of Chemistry and related Sciences.

Suggestions to Science Teachers and Prospective Teachers

We, as Science teachers, are aware that most of the students such as non Science major or North American Indian students are disinterested in Chemistry. The writer believes that the contributions of various Scientists may be used as a vehicle in order to arouse some interest in the subject. For example, contributions and biographical information of various Scientists such as, Dalton, Faraday, Marie Curie, Einstein, Herzberg (nobel Prize winner in Natural Sciences), Banting and Charles Best (Nobel Prize winner in Medicine for the discovery of insulin), Khorana, Nirenberg and Robert W. Holley (Nobel Prize winner in Medicine i.e. the biochemistry of genetics, may be discussed.

Thus, in the opinion of this writer, the subject matter must be correlated with the heritage of students so as to develop pride in their scientifically rich heritage, develop an interest in learning to understand the world in which they live through an understanding of chemistry, and consequently achieve satisfaction from success.

Coming to the specifics of North American Indian students, the writer believes that the most important thing a science teacher can do is to develop pride in the Indian Scientific culture. Also it is necessary for a science teacher to believe basically in the competence of the Indian students with whom he works. The teacher must stress their achievements in science in a class. For example, Chimu Surgeons performed many operations that are a credit to the medical profession of today. These surgeons amputated limbs, trepanned skulls, performed major abdominal operations and filled, crowned and bridged teeth.

The following are some detailed examples of Indian Scientific knowledge which could be easily incorporated in this unit.

A. Production of Yarn and Thread

The native Indians displayed extensive scientific knowledge in their use of the natural fauna and flora of the country to satisfy their requirements for foo, clothing, and shelter.

The following methods have been taken from Arts & Crafts in Chilliwack, B.C.

Mountain Goats' Wool - *SAH-ay

Originally obtained by the Salish by picking shed wool in the high mountains where the Mt. goats spent the summer and shed their old wool. Also obtained from the skins of goats killed for meat. The fresh skin, rolled up with flesh sides together, will, after several days, shed the wool which was plucked off for use in yarn making. The coarse, guard hair of the fleece were removed. A white chalk-like clay was added to the wool, absorbing the grease and leaving the wool with a tendency for the fibers to cling together. Wool was then spun into a box length of yarn, which was later attached to a spindle with which the native spun a yarn suitable for the use intended for the wool.

For the warp of the heavy blankets, two of these strands of yarn were spun into one double strand of warp, simply by attahing the ends of two separate pieces of yarn to the spindle. As the spinning proceeds, the yarn is drawn from two balls, each in a separate container. Domestic wool has almost entirely replaced the Mountain goat wool, which is now rarely obtainable.[1]

Recent scientific research by the author in the area has revealed some interesting information and the older native people of the present day have contributed local details of interest mentioned above, which illustrate Indian uses of the natural sources of their environment.

B. Native Dyes & Natural Dyeing

Indian women were really proficient in the use of vegetable and other dyes. Alder is soft and white but becomes red when exposed to the atmosphere. Hence the bark formed an effective dye, for when chewed the red became brighter and remained a permanent pigment.

The question immediately arises in one's mind. How did these women discover that the substances they used for all these dyes had the property of directly fixing themselves in the texture of materials to which they were applied?

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[1] Oliver N. Wells, Salish Weaving - Primitive and Modern (Sardis: Oliver N. Wells, 1969) pp. 4 - 20

The ancient Indians made little effort to produce ornamentation from colour in the weaving of blankets or other items. Most of the basic colours produced in both woollen and fibre materials were black, yellow, orange and brown.[2]

Black - Sk'ayg - was produced by the boiling of Hemlock or Birch bark with mud containing iron. If an iron pot was used for boiling, the mud was usually left out.

Yellow - Skwiy - was produced from the yellow lichen (Evernia Vulpina) The lichen produces a vivid yellow colour when immersed in water and brought to a boil. The wool was then sumberged in the dye bath until the desired colour was attained.

At present, the Salish Indians are producing these colours with modern mordants such as Alum, Chrome and tin. The primitive mordants used by these people to fix colours were urine, iron and copper.

The Native Indians were well aware of the medicinal properties and effects of many natural compounds derived from plants. Most of our widely used drugs were cultivated and used by Indians of North, South and Central America many countries before Columbus discovered America. Among these are cocaine (from the coca plant of Peru). Quinine and Calisya, Sarsaparilla, Impecachuane, Kaubarb, Wintergreen and Sassafras (sources of Salisylic acid and asprine). Medicine, surgical and herbal were well advanced.

Thus, a science teacher who is teaching in an integrated class must gain knowledge of the rich Indian Scientific Culture in order to impart the meaningful Scientific knowledge to the native Indian students.

Some Practical Suggestions for Developing Pride in a Chemistry Class

1) The science teacher should become acquainted with the scientifically rich culture of the Indian students in his class. This will cultivate better understanding and rapport.

2) The science classroom should be liberally decorated with all aspects of Indian Scientific achievement. For example: Pictorial representation of their scientific way of life should be displayed.

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[2] Alice Ravenhill, The Native Tribes of British Columbia (Victoria: Charles F. Banfield, 1938) pp. 65

(3) The science teachers should discuss the facets of the Indian scientific culture which appear to be superior to those of the dominant culture, e.g., Indians excelled in fishing and hunting. Their knowledge about animal life was very close to perfection.

(4) The science teacher should invite elders of the tribe to visit the classroom and display their customs, crafts and dyeing techniques.

(5) The science teacher should try to correlate contemporary scientific principles with the native Indian Scientific achievements.

(6) The science teacher should encourage Indian students to form a Social unit or science club. In the assemblies Indian and non-Indian students could investigate and discuss together the customs, traditions and Scientific know-how of the North American Indian people.

Contributions of Afro-American Scientists in Chemistry and Applied Science

In this age of modern technology and academic knowledge our Afro-American students are conscious of the pehnomenal advancement of European and post-European cultures, but at the same time they perceive that their own culture or people has contributed little to the present syndrome of technology.

No where is ruthless effacement of a people's pride in their own achievements more evident than in current educational practices of Afro-Americans. Here is a culture who people like George Washington Carver (Agricultural Chemistry) Elijah McCoy (Father of Lubrication), Dr. Charles R. Drew (blood plasma and blood transfusion) Dr. Daniel Hale Williams (Surgeon), Dr. Ernest E. Just (Cytoplasmand nucleus of the cell), Dr. Percy L. Julian (synthesized drugs for arthritis patients) and Dr. Lloyd A. Hall (Food Chemistry), have made outstanding contributions in our scientific world, yet this fact is ignored in the present teaching curriculum.[3]

For detailed information about the above contributions made by Afro-American Scientists, the writer suggests that the teacher should get familiar with a book entitled "Black Pioneers of Science and Invention"by Haber.

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[3]Louis Haber, "The Afro-American Scientist - Why don't We Know Him?" The Science Teacher, May, 1970, p. 46-48.

UNIT II

FUNDAMENTALS OF CHEMISTRY
(Suggested time: 20-25 hrs.)

I Content

Chemical Periodicity

A. Symbol and valance, element, mixture and compound.

B. Atomic Structure and Mole concept

C. Formula, acids, bases and Salt

II Objectives

1. To introduce a theoretical model of the atom based on atomic theory.

2. To provide an understanding of the term valence and mole concept, so that the students may use these terms with meaning.

3. To familiarize the students with the language of chemistry.

III References

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William E. Price and George H. Bruce, Chemistry and Human Affairs (New York: World Book Company, 1949)

Board of Education of the city of New York. Applied Chemistry for High Schools (New York: Board of Education of the City of New York, 1959)

Content	Examples, Apparatus and Material	Activities	Evaluation
Problem II-A What do you mean by element, mixture and compound?	Refer to Experiments discussed in Science 10 (Electrolytic conductivity of compounds).	Have the students discuss the electrolysis of water and other solutions which has been discussed in the previous unit and in Sc. 10 The teacher should introduce the concept of element and compound by using the above examples of water. Define compound as the union of two or more elements chemically to give a new substance. Differentiate compound from a mixture.	The students are asked to make a list of elements and compounds used in their home.
	Sand Sugar Beaker Water Bunsen Burner	<u>Demonstration III-A</u> Mix sand and sugar, then separate these components. Have the students discuss whether the above combination is a compound or a mixture. Separate the mixture of sand and sugar by dissolving in water. Evaporate the filtrate and emphasize that in mixture original components are separated.	The students are required to write an operational definition of each (mixture and compound) in their note books.
	Fertilizers Iron Sand Sugar Table Salt	Have the students discuss at least ten examples of elements, mixtures and compounds from the town using the above concepts. Give a brief lecture on the number of elements and the organization of elements in the periodic table.	The students will be evaluated from their active participation in the class.

Content	Examples, Apparatus and Material	Activities	Evaluation
Problem II-B What do you mean by symbol?		The teacher should write the symbols for carbon, nitrogen, oxygen sulphur, hydrogen a and phosphorus on the black board. Have the students make an operational definition of symbol. Show the necessity for using the symbols. The students should be given a symbol sheet and asked to use symbol sheet frequently so that after some time, by using this sheet constantly, they will know some of the common symbols eventually without actually memorizing them.	The students are asked to write the symbols of the substances available in their home, e.g., nail (iron nail), cu-plate (copper-plate)
Problem II-C What is an atom and what is it made of?	Models of various atoms.	The teacher should give a lecture on the concept of atoms with reference to the demonstration on the electrolysis of water. In the lecture, explain the concept of atom, giving historical background. Include the major parts of Dalton's Atomic Theory; indivisibility of atoms: atoms remain unchanged in the Chemical action. Emphasize Sir J.J. Thomson and Rutherford contributionsto the structure of atom and then lead the students to Bohr's atomic theory with reference to electrolysis of water and state that atom consists of three fundamental particles: a) electrons b) protons	

Content	Examples, Apparatus and Material	Activities	Evaluation
		c) neutrons State the charge, weight and location of the particles. Define atomic weight and atomic numbers. Compare the Bohr structure of the atom with the solar system. The students should be given the idea of the existence of other atomic theories as this would be especially useful for those students who might be more interested in atomic structure. Drill students on drawing diagrams for the first twenty elements, atomic weight and atomic number being given. The teacher should explain this behaviour of atoms as resembling persons in the way they behave toward one another. Example: Hydrogen atom possesses a great liking for oxygen atoms that are indifferent to iron atoms. He can discuss the concept of molecule as the union of two or more atoms. The concept of chemical combination can be explained as a game played by the surface electrons. The teacher can give the importance of the electrons of the outer shell which are called valence electrons.	After completing the drill period, the students will be evaluated with a short quiz on atomic structure.
Problem II-D Why and how atoms combine (valence)?			

Content	Examples, Apparatus and Material	Activities	Evaluation
Problem II-E What is formula and how do you write it?		Have the students review Bohr structure of the atom and define the valence electrons. Explain to the students the importance of valence in writing correct chemical formula. The valence sheet will be provided to the students. The students should be made to understand what valence means, i.e., combining capacity of an element. Give examples of formulas of known compounds e.g., water (H_2O) and then have the students give the definition of formula in their own words. Tell the students two important factors, (a) symbol (b) valence, on which the chemical formula depends. Explain to the students how to write a correct chemical formula e.g., sodium chloride. The symbol of sodium is Na and valency is +1. The symbol for chloride is Cl, and valency is -1. In order to write a correct chemical formula we should have an equal and opposite number of charges. $Na^{+1}\ Cl^{-1} = NaCl$ (sodium chloride)	The students are required to write an operational definition of the formula in their note books.
Problem II-G What is a mole?		Define "mole" as the number of grams of any substance which is exactly equal to its	

Content	Examples, Apparatus and Material	Activities	Evaluation
		molecular weight or atomic weight. Give some examples to find one mole of sulph ic acid. Emphasize that the importance of a mole is most usefully connected with the no. of particles (6.0×10^{23}) rather than weight. Discuss some mathematical problems to justify the above concept.	
Problem II-H How do you express the composition of solutions?		The teacher should mention that chemists often indicate the concentration of a substance solution in terms of the substance dissolved per liter of solution. This is called the MOLAR CONCENTRATION. Thus, IM NaCl means one mole of NaCl to be dissolved in enough solvent (water) so that the total volume is equal to 1 liter. Have the students write directions for the preparation of the following solutions (i) 1.0 liter of 1.OM, Potassium Nitrate, KNO_3 (ii) 3.0 liters of 2.OM Potassium Nitrate (iii) .50 liter of .50M KNO_3 Experiment II-1 To prepare the following solutions of given concentration	The students will be evaluated from the following molar concentration questions. How would you prepare: (a) 200 ml of .5MHcl (b) .50 liter of 2.0 M K_2Cro_4 solution (c) 200 ml 1M CH_3COOH (d) 200 ml 1M HNO_3

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Content	Examples, Apparatus and Material	Activities	Evaluation
	Beaker Glass rod Balance Bunsen Burner Sodium chloride potassium nitrate solut. hydrochloric acid	(1) Prepare 100 ml of .5 MHcl (2) 100 ml of 1MNacl (3) 6 ml of .1MNacl (4) 100 ml of 1M KNO_3	The students are required to show their complete method of calculations of the corresponding molar concentrations.
Problem II-1 What is a chemical reaction?	Sodium chloride solution Silver nitrate solution Beaker	<u>Demonstration II-B</u> Mix sodium chloride solution with silver nitrate solution. Have the students discuss the results of the above demonstration. The teacher should discuss the concept of chemical reaction and tell the students wher a chemical reaction takes place, a new substance is formed with quite new properties.	
What is a chemical equation?		Have the students write down the chemical formulas of the reactants and the products. The teacher should discuss the concept of chemical equation as a symbolic representation of a chemical reaction from the above demonstration. Tell the students how to balance chemical equations in an ionic form.	The students will be asked to complete and balance the following equations. $Al(OH)_3 + H_2SO_4 \longrightarrow$ $Al(OH)_3 + HCl \longrightarrow$

Content	Examples, Apparatus and Material	Activities	Evaluation
		Demonstration II-C	
Problem II-J What is an acid and a base?	Common fruit (lemon) vegetable soda water litmus paper wood ash	Test juice from common fruits and vegetables from the village with red and blue litmus paper. Test carbonated drinks with litmus paper. Have the students make an operational definition of an acid and a base. Write the formulas of acids and bases on the board and ask the students to make generalizations about acids and bases by inspecting their formulas. Be sure to have students eventually make the statement that all acids contain H^+ ions and bases generally contain OH^- ions. Mention that the above definition is Arrhenius' concept of an acid and a base.	The students are asked to write an operational definition of acid and base in their note books. The students are asked to make generalizations from the formulas of acids and bases.
Problem II-K What happens when acids react with bases?	Sodium hydroxide Hydrochloric Acid Beaker Water	Demonstration II-D Mix excess HCl with NaOH. Evaporate the mixture. Have the students note the observations and taste the salt. Have the students write down the definition of salt formation.	The students are required to record the observations and write an operational definition of salt formation.

Content	Examples, Apparatus and Material	Activities	Evaluation
Problem II-L What are the uses of salts, acids and bases in our daily lives?	Ammonium chloride Copper sulphate Sodium bicarbonate Sodium nitrate	Exhibit sodium chloride, ammonium chloride, and sodium nitrate. State some important uses of salts, such as manufacture of baking soda. State some important uses of acids, such as manufacture of fertilizers explosives and rayon. State some important uses of bases in their daily life, e.g., Sodium hydroxide (should be handled carefully) can be used for cleaning drains and also used in making soap. State the fact that calcium hydroxide is use used in making mortar, plaster or whitewash Magnesium hydroxide is used in making tooth powder.	The students are required to make a list of the salts used in homes.
Summary Question What concepts discussed in this class are you going to apply in your daily life?		Round Table Conference Have the students discuss the application of these concepts in their daily life. The teacher should also participate in the conference by giving some more applications of acids which have not been discussed in the class.	The students will be evaluated from their participation in the class.

CHEMISTRY HELPS US TO USE WATER AND AIR

SAFELY AND TO CONSERVE IT
(suggested time: 5 weeks)

I. Content

A. Three states of water

B. Natural sources of water

C. Water pollution

D. Methods of purification of water

E. Chemical composition of water

F. Physical and chemical change

G. Air pollution

II. Objectives

(1) To impart information to the students on how chemistry can help the people make more healthful and effective use of water and air in the community.

(2) To familiarise the students with the problem of man made pollution and how to overcome the problem of air and water pollution.

(3) To provide the students with an understanding of the methods used in changing matter from one physical form to another.

III. References for the Teacher

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H. J. MacDonald, "Through a Glass Darkly - Our Drinking Water Can't be Trusted", Weekend Magazine, (Montreal: The Montreal Standard Publishing Company Ltd.) vol. 23, No. 11, March 17, 1973.

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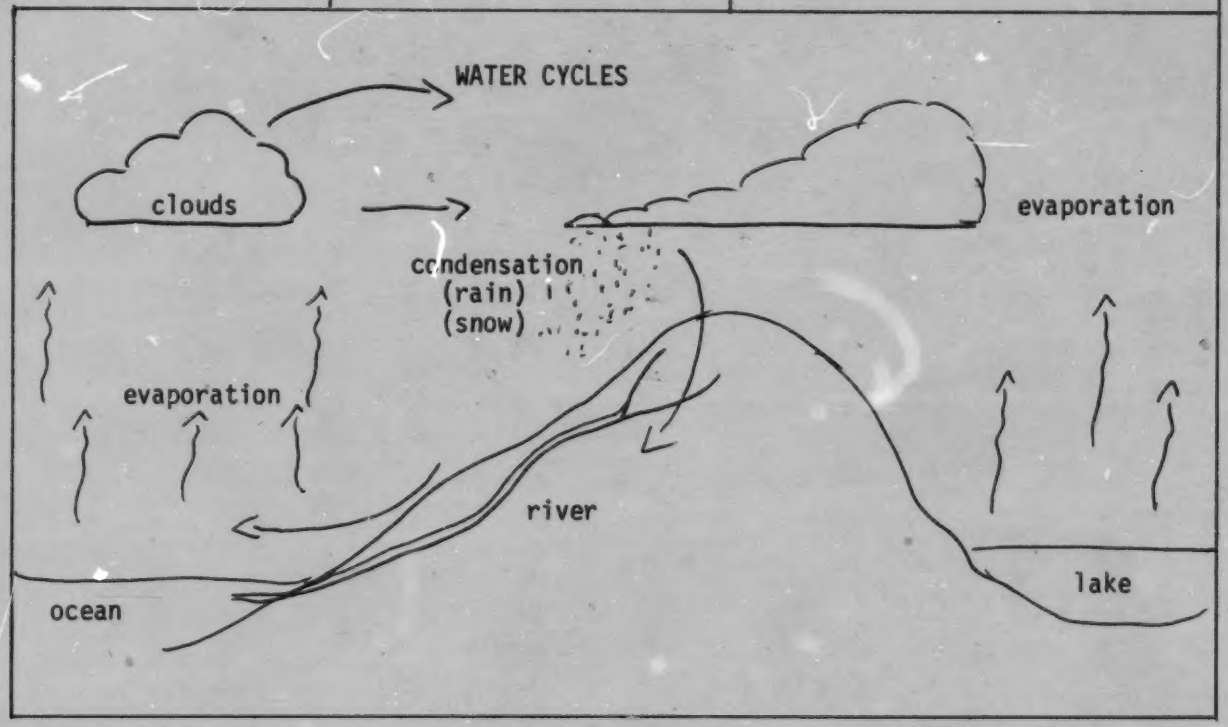
Content	Examples, Apparatus and Material	Activities	Evaluation
Problem III- A: In how many physical states does water exist? Problem III- B: What are the common sources of water? Problem III- C: How can we demonstrate the phenomenon of evaporation and condensation in our lab?	water flask condenser bunsen burner	<u>Demonstration III- A</u> Demonstrate the three physical states of matter using water (solid state - ice, vapor state - steam, liquid state - water) Have the students discuss the sources and abundancies of water upon the earth's surface. Discuss the natural formation of rain water. Discuss the phenomenon of evaporation and condensation. <u>Experiment III- 1</u> Introduction to Evaporation and condensation. Have the	The students are asked to note the observations in their notebooks and describe the different states of matter.

Content	Examples, Apparatus and Material	Activites	Evaluation
		students investigate the phenomenon of evaporation from wide mouthed jars and by boiling. Procedure (Instruction for the students) Part 1	
	wide mouthed bottles masking tape	(1) obtain several wide mouthed bottles. Fill the bottles with varying amounts of water. Mark the level of the water in the bottles with masking tape or rubber bands. (2) Place the bottles near window and let them stand. (3) After several hours observe what has happened to the level	

Content	Examples, Apparatus and Material	Activities	Evaluation
		of water in the bottles. Record these observations in your laboratory note book. (4) Leave the bottles untouched near the window over night. (5) Next day observe what has happened to the water level in the jar. Record these observations in your lab note book.	
	500 ml beaker bunsen burner wire gauze	<u>Part II</u> (1) Obtain a 500 ml beaker. Fill this with 400 ml tap water. (2) Place the beaker on a ring stand and place a bunsen burner under the ring stand with a wire gauze. Continue heating the water in this manner until it	

Content	Examples, Apparatus and Material	Activities	Evaluation
		comes to a boil. (3) Let the water boil for about 15 minutes. Observe what has happened to the water level.	The students will be evaluated from the following question: "From your observations, attempt to explain what happened to the water in the jars near the window and in the beaker of boiling water. Use the concept of Evaporation in your explanations
	1000 ml beaker colour (red or blue) Ice	Part III (1) Obtain a 1000 ml beaker. Fill this 3/4 full with cool tap water. Add several ice cubes to the water. (2) Using a suitable colour, (preferably dark) colour the water in the beaker. (3) After a few minutes feel the outside of the beaker. Note the colour of the water on the outside of the beaker. (The above phenomenon of	The students will be evaluated from the following question: "From your observations, attempt to explain where

Content	Examples, Apparatus and Material	Activities	Evaluation
		condensation can also be demonstrated by inverting a jar over burning candle.)	the water on the outside of the beaker (in part III) came from. Make reference to "condensation" and "water vapour"



Additional Questions

Attempt to explain in the terms of evaporation condensation, what becomes of the water in our oceans, rivers, lakes and atmosphere. Try to devise a cycle to explain the processes involved. (refer to diagram I)

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Content	Examples, Apparatus and Material	Activities	Evaluation
Problem III - D: Is our drinking water fit for consumption?	Local drinking water Beaker wire gauze bunsen burner microscope	<u>Demonstration III - B</u>: (a) Evaporate some drinkable water in a beaker and show the residue to the students. (b) Observe sample of local river water under microscope. Have the students discuss the above demonstration. Discuss the problem of water pollution in our continent.	The students are required to record the observations in their note books and discuss in the class.
Problem III - E: What is water pollution?		The teacher should emphasize that the major portion of the earth's water is not fit for drinking due to man made pollution.	

Content	Examples, Apparatus and Material	Activities	Evaluation

He should also point out that one hundredth of one percent of the world's water sustains earth's total population.

Experiment III- 2

An Elementary Study of Water Pollution

Provide three samples of water (tap water #1, distilled water #2, and mineral water #3) and ask the students to identify each according to the following data table.

Data Table

	Water #1	Water #2	Water #3
Taste			
Colour			
Any other Difference			

Content	Examples, Apparatus and Material	Activities	Evaluation
		Ask the students to compare the results with other members of the class.	The students are required to note the observations in their note books and answer the following question "what causes some water to be different than others?"
		The teacher should emphasize that man made pollution is a serious threat to our society. This problem of pollution is a contribution of our modern society. Emphasize that there	

Content	Examples, Apparatus and Material	Activities	Evaluation
What are main types of water pollution?		was a very limited problem of water pollution before the white man came to this continent. The teacher should explain three main types of water pollution: poisoning with pesticides, bulk sewage and the water entroplication. Poisoning with pesticides is another fairly serious problem. Many pesticides such as sodium flouride, hydrogen cyanide and many arsenic compounds like lead arsenate, calcium arsenate are used in great quantities to kill bugs.	

Content	Examples, Apparatus and Material	Activities	Evaluation
		Fish caught far out in the sea have been examined and found to contain these poisons. Bulk sewage is a serious pollution problem. Untreated water from sewage pipes carry bulk debris into the dumping waters. Most of the debris is toilet paper and dumping water. The worst type of water pollution is entroplication, meaning well nourished. To quote Dr. Francis T. Mayo, Great Lakes Regional Director of the Federal Water Quality	

Content	Examples, Apparatus and Material	Activities	Evaluation
		Administration, "A Lake becomes over nourished as part of its normal aging process, but man accelerates the process tremendously by pouring in nutrients and industrial chemicals."[1] The main source of nutrients are sewage, industrial wastes, farm fertilizers, and worst of all soap.	
Problem III- E: What are the harmful effects of impure		Field Trip III- A Arrange a field trip to visit the reserve and observe the	

[1] Young, op. cit, p-2

Content	Examples, Apparatus and Material	Activities	Evaluation
drinking water.		impurities in the natural water. Discuss the danger of contracting typhoid from impure drinking water and parasites such as amoeba are serious dangers in impure water. The teacher may quote H. J. MacDonald from his article Through A Glass Darkly - Our drinking water can't be trusted "In Skaha, B.C., in 1968, residents suffered mysterious intestinal troubles, allergies and infectious rashes, attributed to massive algae growth	

Content	Examples, Apparatus and Material	Activities	Evaluation
		from pollution in the area's drinking water source"[2] The students are asked to discuss at home the harmful effects of impure drinking water and report the results of the discussion to the class. <u>Round Table Conference</u> Have the students sit in a circle with the teacher in the center. The students are asked to discuss their parents' reaction to the harmful effects of water.	The students will be evaluated from their verbal report of their parents' reaction.

2 MacDonald, Op. cit, p.1

Content	Examples, Apparatus and Material	Activities	Evaluation
Problem II - F: How can we purify our drinkable water? (a) Distillation	Distillation flask Bunsen burner Wire gauze Distillation equipment Filter paper Funnel Beaker	The teacher should explain the distillation process. Experiment III- 3 Methods of making water potable. Distillation: The students are required to set up the distillation equipment as shown in the labelled diagram drawn by the teacher on the black board. Have the students distil drinkable water and keep the residue as well as distillate. Have the students discuss the applicability of distillation in the community for purifi-	The students are required to note the observations in their note books and are asked to describe the principles involved in distillation in their notebooks.

Content	Examples, Apparatus and Material	Activities	Evaluation
		cation of drinking water. The teacher whould help in concluding the discussion that distillation is a good laboratory method, but it is used in small scale.	
(b) Sedimentation	Chalk Mud Beaker containing water	Demonstration III - C Put a lump of mud or chalk from the village in water and disperse it. Allow the beaker to stand for 15 minutes. Discuss the use of settling basins in purification of water.	The students are asked to write the process of sedimentation in their own words.
(c) Filtration	Chalk Gravel Coarse & fine sand	Demonstration III - D Demonstrate the filtration of a chalk suspension through	The students are asked to write the

Content	Examples, Apparatus and Material	Activities	Evaluation
		a filter bed consisting of gravel, coarse and fine sand.	process of filtration in their note books and will be evaluated from their explanation of filtration process.
(d) Aeration	Beaker Bunsen Burner Local drinking water	Demonstration III- E Have the students taste the local drinking water before boiling and after boiling. The students are led into discussion and a conclusion can be drawn that aeration can be achieved by spraying water into air or allowing water to flow over rocky masses.	

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Content	Examples, Apparatus and Material	Activities	Evaluation
(e) Use of bleach	Drinking water Beaker Bleach	Experiment III- 4 Have the students purify water by the use of bleach. Add a few drops of bleach to the impure water. Tell the students that chlorine is used in killing disease-producing bacteria. Field Trip III- B Arrange a trip to visit the nearest town to demonstrate the process of chlorination and filtration used in the municipal purification unit.	The students are asked to purify the sample of impure water brought from their homes and check it. The students are required to write a report on the methods used in the purification of drinking water in your community.

Content	Examples, Apparatus and Material	Activities	Evaluation
Problem III- G: What should be the characteristic of our drinking water?	Samples of local drinking water Distilled water	Have the students compare the above samples and discuss and help them in summarizing the differences (a) Pure water is free from all harmful bacteria and the desirability is that it should be colourless, odourless and pleasant in taste.	The students are required to write down the characteristics of drinking water.
Problem III- H: (optional) What is the chemical composition of water by volume?	Beaker Water Lead or carbon electrodes Sulphuric Acid	Demonstration III-F Electrolyze water containing a small amount of H_2SO_4 using lead or carbon electrodes. Emphasize the volume relationship of the hydrogen and oxygen produced. Do reverse also	The students are required to make observations in their note books and discuss the observations in their class.

Content	Examples, Apparatus and Material	Activities	Evaluation
		and combine two volumes of hydrogen and one volume of oxygen. Have the students discuss the above demonstrations and develop an operational definition of chemical formula. The teacher should review the concept of chemical and physical change by above demonstration of water. He should compare the above changes by giving the examples of electrolysis and boiling of water.	The students are required to write an operational definition of chemical formulas, chemical and physical changes in their own words.
Problem III- I: What is air pollution	Photographs or pictures concerning air pollution from various	Experiment III- 5 Have the students examine photographs concerning air	

Content	Examples, Apparatus and Material	Activities	Evaluation
	sources such as automobile, industry etc.	pollution from various man made sources. Also, have the students examine natural sources of air pollutants and identify the pollutants in air in your community. Procedure Part I (1) Obtain various old picture magazines which will be supplied to you by your teacher. (2) Find a number of pictures illustrating the causes of air pollution. (3) Classify the pictures according to natural pollution	The students are required to note the observations in their note books and are asked to answer the following question: "Suggest ways to reduce air pollution."

Content	Examples, Apparatus and Material	Activities	Evaluation
		and man-made pollution. (4) Further classify your material into various other headings, e.g., natural pollution by pollen producing plants, by volcanic action. <u>Part II</u> (1) Obtain several utility pails and fill them half full of water. (2) Place the pails in unprotected outdoor areas such as, near window. (3) After 24 hours check for evidences of foreign matter. Leave the pails untouched.	

Content	Examples, Apparatus and Material	Activities	Evaluation

(4) After one week, check again for evidences of foreign matter.

(5) Collect the material in your pail with cheese cloth. Identify as much material as you can.

(6) Compare with other students.

Part III

(1) List samples of pollutants found in your reserves or residence.

(2) Divide these samples with natural and man-made pollutants and place in a data table.

Data Table

Pollutants	Natural	Man Made	Harmful To People
cars	-	x	x
smoke	-	x	x
sand-storms	x	-	x

Content	Examples, Apparatus and Material	Activities	Evaluation
Summary Question How can we overcome the problem of pollution in our community?		Round Table Conference Have the students discuss various methods of overcoming the problems of pollution.	The students will be evaluated from their active participation in the discussion.

UNIT IV

CHEMISTRY IN HOME AND IN FARMING (AGRICULTURE)
(Suggested Time: 25 - 30 hrs.)

II Content

A. Chemistry of building material

B. Soils and Fertilizers

C. Importance of Chemistry in Keeping Your Farm Productive

II General Objectives

1. To familiarize the students with the application of chemistry in the home and farming.

2. To emphasize the importance of Chemistry in the student's daily life.

SPECIFIC OBJECTIVES

1. To emphasize the students the application of Chemistry in building materials such as cement, lime, plastic and glass, etc.

2. To collect, observe and test different kinds of soil and to develop an understanding of the following concepts in the students. (Refer to Content B)

(a) There are different kinds of soil: sandy, clay, loam and humus.

(b) Plants can grow in substitutes for soil.

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Your Farm and How to Keep it Productive, Montreal: Cyanamid of Canada Limited, 1965, p. 1-13

Content	Examples, Apparatus and Material	Activities	Evaluation
Problem IV--A What is the chemistry of building materials?	cement lime plaster glass insulating material	Exhibit the most important chemical materials used in building materials, e.g., cement, lime, plaster, glass and insulating material. Field Trip Arrange a field trip to study the use of material and effects of weather on those materials in the community.	The students are asked to make a list of the important chemical substance in building materials.
Problem IV-B What are the chemicals that remove dirt and stains from the homes?	chlorine water bleach beaker	Have the students bring some bleached and unbleached clothes from their homes. Discuss the importance of bleaching as a preparation for dyeing. Demonstration IV-A Place a sample of dried unbleached muslin and also a wet sample of the same material in a jar of chlorine gas. (Bleach can be used.) Give a lecture emphasizing the chemistry of bleaching process as a chemical process of changing the natural coloring matter of textile into colorless compounds. The teacher should give a lecture on the role of chlorine and oxygen in bleaching.	The students are required to write the observations in their notebooks and write down the action of bleach on the dirt. The students are asked to write an operational definition of the process

Content	Examples, Apparatus and Material	Activities	Evaluation
			of bleaching in their own words in their notebooks
b) soap	sodium hydroxide vegetable or animal fat or oil beaker	DEMONSTRATION Cleaning with soap: Prepare a sample of soap by heating animal and vegetable fat or oil to a boil in a solution of sodium hydroxide. When the process is finally judged complete, the mixture of soap glycerol and water is separated by adding salt, the soap rises to the top of kettle. Demonstrate the cleaning of a soiled fabric in water with and without soap. Emphasize that soap is necessary to' remove dirt in laundering and it is very important from separating out of solution. At the surface of some oild the hydrophile portion (carbonyl group) is attracted to the water. With sufficient agitation, the oil can be broken up into tiny droplets. The teacher may discuss the role of detergent in removing dirt from clothes. Give a lecture on the uses of by-products of glycerine. Demonstration IV-C Have the students demonstrate the	The students are asked to summarize steps needed in making of a soap in their note books.

Content	Examples, Apparatus and Material	Activities	Evaluation
		difference between the following cylinders containing to clean the body with soap as it kills certain bacteria. Give a lecture on the theory of the action of soap. Explain to the students that the dirt is not attracted to water, does not dissolve or disperse in water. In the case of soap, groups of soap ions clump together in ball-like shapes with their hydrocarbon ends towards the center and the salt end toward water. The water insoluble portions, thus preventing the soap A) water and oil B) water, oil and soap.	The students will be evaluated from their verbal response on the action of water oil mixture and water oil and soap mixture. The students are asked to write a report on health hazards amd the use of solvents in their note books.
Problem IV-C How to remove spots and stains from the clothes?	clothes with stains benzene methyl alcohol carbon tetrachloride	Have the students bring the clothes from their homes which have stains of ink, rust paint and grease. Give a lecture on the usage of organic solvents like benzene, methyl alcohol, carbon tetrachloride to clean and remove the spots and stains from the clothes. Mention some of the health hazards of using these solvents e.g., poisonous vapours, explosive vapours. etc.	
Problem IV-D What does your soil do for you?		The teacher should emphasize the importance of soil in the plant growth. For example, it gives a mechanical support to plants. Soil also provides nutrients which are	

Content	Examples, Apparatus and Material	Activities	Evaluation
		essential for plant growth. Have the students discuss the composition of soil at home.	
Problem IV-E			
What is the composition of soil?	mineral oil organic soil	The teacher should give a lecture on the composition of the soil. For example, soil is composed of minerals organic matter water and air. Organic soils such as peats are those soils which contain over 20" organic matter. The most abundant elements found in organic soils are carbon, oxygen and hydrogen with nitrogen, phosphorus and sulphur - present in lesser amounts. Mineral soils are those soils which contain less than 20% of organic matter. These soils contain oxides of hydrogen, silicon, aluminum and iron as the most common components. Oxides of silicon, aluminum and iron make up at least 90% of the mineral portion.	
Problem IV-F			
What are different kinds of soils?	Various containers containing different kinds of soil such as: 1) sandy 2) clay 3) loam 4) humus	Activity Have the students observe different kinds of soils and discuss the effect of climate on soil of the community. The teacher should discuss man's dependence on plants for food.	The students are required to write a report on different kinds of soil in the local community.

Content	Examples, Apparatus and Material	Activities	Evaluation
Problem IV-G What are mineral fertilizers?	common fertilizers which are used in the local community	Have the students discuss the role of mineral fertilizer (nitrate, phosphate, potassium and micro fertilizers) in farming their composition and their simple properties and methods of identification should be discussed. Field Trip Arrange a trip to the farms in the community and explain the uses of different types of fertilizers. Experiment Have the students grow the plants with or without fertilizers. The students should take different amounts of fertilizers and a record should be kept for the maximum growth of a plant with a certain amount of fertilizer.	The students are required to write a report on the advantages of fertilizers in farming and the need for proper application. The students are asked to record their observations in their notebooks and discuss it in the class.
Problem IV-H What are various factors on which the fertility of the soil depends?		The fertility of the soil depends upon the composition of the soil. If the soil becomes deficient in certain elements fertilizers can be utilized to add these elements to the soil. Explain the following steps to soil fertility:	

Content	Examples, Apparatus and Material	Activities	Evaluation
		1) Improving Drainage Without proper drainage, added lime and fertilizers are practically useless. Thus, establishing a good drainage system is the first step in increasing soil fertility 2) Liming Liming neutralizes the soil acidity and promotes the growth of organic matter decomposing bacteria. It also improves the physical condition of heavy clay soils. Limestone also supplies calcium and magnesium which are needed by plants to build cell walls. 3) Organic Matter Organic matter eventually breaks down into humus, the main source of natural fertility in the soil. The humus is constantly being lost through frequent cultivation. Organic matter can be supplied by the addition of manure. 4) Phosphorus The fourth step is to build an adequate phosphorus content. Phosphorus is essential for root development, the formation of flower parts and seeds.	

Content	Examples, Apparatus and Material	Activities	Evaluation
		5) Potassium Potassium has much to do with the general tone and vigour of the plants grown. It is essential for the growth of cereal grains, tubular development and is recommended for all root crops. 6) Nitrogen Nitrogen is essential for the growing crop, and also for the decomposition of crop refuse to productive humus by bacteria. Nitrogen is available in many types of commercial fertilizers such as Urea fertilizers and Ammonium Nitrate fertilizers. 7) Mixed Fertilizers Mixed fertilizers are of much value to the farmer. A soil test will tell the farmer which combination is best suited to his needs.	
Problem IV-I How can we protect our crops against weeds, insects and diseases?		The teacher should emphasize that many chemicals have been developed to combat these pests. Soil insects are best controlled by chemicals such as Aldrin, dieldrin, or chlordane.	

Content	Examples, Apparatus and Material	Activities	Evaluation
		Foliar insects are easily controlled by Malathion, DDT, etc. The two main groups of insecticides include: (a) Chlormated Hydrocarbon e.g., DDT, Lindane, Chlordane. (b) Organic Phosphates e.g., malathion, phosdrin, parathion. Weed Control Weeds rob the soil of nutrients essential to the crops. There are many types of Chemicals which are used for killing weeds. Disease Control Three types of harmful disease exist among the plants: (a) Virus (b) Fungi (c) Bacterial (a) Virus diseases are found mostly on the foliage such as tobacco and potatoe mosiac. Virus disease can be controlled by: (i) Killing disease spreading insects (ii) Rotating crops (iii) Cleaning up and destroying refuse	

Content	Examples, Apparatus and Material	Activities	Evaluation
		(b) Fungi diseases attach different parts of the plants. Some common fungus diseases are damping off. Fungus diseases can be controlled by such furgicides as copper sulphate, lime, sulphur and carbamates. (c) Bacterial diseases are spread either by water or by insects. Some bacterial diseases are bacterial leaf spot of beans. Field trip The teacher should arrange a field trip to the community farms so that the students can observe the above diseases or other pertinent information. Activity Have the students discuss the above information at home with their parents.	The students are asked to write a short report on the protection of our crops against weeds insects and disease.
Problem IV-J What do you mean by Animal Nutrition?		Round Table Conference The teacher should have a round table conference and lead a discussion about the information obtained by the students from the above activity. The teacher should emphasize the efficient feeding of poultry and livestock has become of prime importance in livestock management. Good nutritional practices in feeding increases	The students will be evaluated corresponding to their participation in the round table conference.

Content	Examples, Apparatus and Material	Activities	Evaluation
		efficiency so the farmer attempts to concern himself primarily with nutrition. The following five types of nutrients are of major importance: (a) Proteins Proteins are essential for life. Proteins are composed of amino acids which consist of nitrogen, carbon, hydrogen and oxygen combined in various ways. (b) Carbohydrates and Fats These supply energy to the body. Carbohydrates are made up of carbon, hydrogen and oxygen in varying amounts. (c) Minerals Minerals are necessary nutritional components for the building of bones. They are also necessary for other vital body functions. Minerals such as Calcium, Magnesium, iron and copper are generally used, other essential minerals are, manganese, magnesium, iodine cobalt and zinc in varying amounts. (d) Vitamins Vitamins are broadly classified into two groups: (i) The fat soluble vitamins	

Content	Examples, Apparatus and Material	Activities	Evaluation
		(e.g. Vit, A,D,E, & K) (ii) The water soluble Vitamins, (e.g. the B complex)	
Summary Question What concepts discussed in this unit are you going to apply in your daily life?		Round Table Conference Have the students discuss the application of the concepts discussed in this unit in their daily lives.	The students will be evaluated from their participation in the class discussion.

UNIT V

PSYCHIC DRUGS AND YOU
(suggested time: 20-25 hrs.)

I Content

A. Major categories of drugs

B. Medicinal uses and abuses of:

(i) Tranquilizers
(ii) Narcotics
(iii) Hallucinogens
(iv) Stimulants
(v) Sedatives
(vi) Miscellaneous

C. Suggested activities regarding drug education

II Objectives

1. To provide an understanding of the effects of drug abuse, so that the students may be aware of hazardous effects of these drugs.

2. To familiarize the students with the various psychic drugs which are used by drug users and pushers.

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Content	Examples, Apparatus and Material	Activities	Evaluation
Problem V-1			
What are major categories of drugs?		Tell the students that there are six major categories of drugs: 1. Tranquilizers 2. Narcotics 3. Hallucinogens 4. Stimulants 5. Sedatives 6. Miscellaneous	
What are medical uses and abuses of the following drugs: 1. Tranquilizers		Define the above categories of drugs. For example, tranquilizers are drugs which are used to induce calmness, reduce tensions and anxiety. These drugs are available in the form of colored pills and capsules. Chronic abuse of these drugs may result in the development of physical or psychological dependence. Excessive use may cause side effects: Headache, skin rashes, stomach disturbances, urinary frequency, withdrawal symptoms, include insomnia, vomiting, shaking, loss of appetite, lack of muscular co-ordination, fever and on occasion, death. This drug when taken with alcohol can produce hazardous effects. The most frequent tranquilizers diverted into illicit trade are meprobamate (equinil, Miltown) and glutethimide (Doriden)	Have the students write a short report on hazardous effects of the abuse of tranquilizers.

Content	Examples, Apparatus and Material	Activities	Evaluation
Problem V-2			
What do you mean by physical and psychological dependence?		Have the students discuss the terms of physical and psychological dependence. Summarize the state of physical dependence as a state of adaptation to a drug such that signs and symptoms of bodily discomfort appear when the drug is withdrawn abruptly. Also, summarize psychological dependence as a strong emotional or mental drive to take a drug, either to obtain pleasure or to avoid discomfort.	
2. Narcotics drugs like: a. Morphine (M, Mary, White Mojo)		Tell the students that natural and synthetic morphine like drugs are the most effective pain relievers. Morphine is available as fluffy, white powder found in cubes or tablets and is extremely bitter. These may be eaten or injected under the skin or intravenously. These drugs produce a sense of euphoria (an exaggerated sense of well being) drowsiness, nausea, urinary retention. In severe cases, the user may go into a coma. Death results when individual can no longer breathe.	Have the students discuss hazardous effects of narcotic drugs?

Content	Examples, Apparatus and Material	Activities	Evaluation
		Morphine users are generally lethargic and indifferent to their environments and personal situation. Hazardous effects of this morphine are physical and psychological dependence, painful withdrawal symptoms, destruction of brain and liver, danger of acquiring hepatitis from contaminated needle and death from overdose.	
b. Heroin (H, stuff, jumk, horse, smack, Harry, dynamite)		Heroin is available as a white crystalline powder, slightly bitter. May be sniffed (rare) taken by mouth or injected under the skin or intravenously. Signs and symptoms and hazardous effects are the same as morphine.	The students are required to write a short report on symptoms and hazardous effects of Heroin.
c. Codeine		Tell the students that codeine is approximately one-tenth as toxic as morphine. Codeine is usually available in form of tablets or in cough syrups. Signs and symptoms and hazardous effects are the same as morphine but milder.	
d. Hallucinogens		Tell the students that hallucinogens are drugs which cause hallucinations. These drugs produce distortion of perception, and dream images. These are called psychedelics.	Have the students discuss major hazardous effects of narcotic drugs. The students will be evaluated according to their participation in the class discussion

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Content	Examples, Apparatus and Material	Activities	Evaluation
3. Hallucinogens a. Toxic solvents, such as glue, nail polish remover and gasoline		Tell the students that frequent use of the tonic solvents mentioned in previous columns produce psychological dependence, dizziness, headache, nausea, slurred speech, and blurred vision and feelings of euphoria.	
b. Marijuana (cannibas) pot, Mary Jane, Tea, weed, grass, Mary Warner, rope, hemp, jive)		Hazardous effects are to brain, liver, kidney and possible death due to suffocation. Users generally have sweetish sickly odour on breath and clothing. Tell the students that massive doses of marijauna may cause altered awareness of time and space, visual distortions, hallucinations. Mood changes, ranging from anxiety at first to euphoria may occur. Marijauna is brownish green, dried and shredded leaves with a pungent smell. It is smoked in a type of pipe or inhaler or as cigarettes.	
c. Hashish (hash)		Tell the students that Hashish is available as a dark amber resinous material extracted from the flowering tops of the cannabis plant. The darker the colour and the harder the substance. It is smoked in a pipe or in a cigarette. Symptoms and hazardous effects are same as Marijuana.	
d. LSD (d-Lyserigic acid diethylamide)		Tell the students that LSD was synthesized in 1938 from lysergic acid present in	

Content	Examples, Apparatus and Material	Activities	Evaluation
Common name: acid, the chief, the hawk, the cube, big oz, orange, wedge, sugar, 4-way, Big "A"		fungus that grows on rye and is available in the form of white powder or tablets or liquids or soaked into sugar cubes, cloth or blotting paper. LSD mainly affects the central nervous system resulting in a change of mood and sometimes behavior. Hazardous effects involve physical and psychological dependence extremely horrifying hallucinations (bad trip or bum trip.) LSD may lead to chromosome damage and birth defects and suicidal urge.	
e. Mescaline (Dimethyl tryptamine) (common name: Mescal buttons, cactus peyote)		Tell the students that mescaline is obtained from the Mexican cactus Anhalonium. It is available in the form of gelatin capsules or in a form to be mixed with water or injected intravenously Hazardous effects and signs and symptoms are same as that of LSD.	
f. STP (Serenity, tranquility, peace DOM)		Tell the students that STP is available in the form of blue or orange capsules or tablets which are swallowed. The peak effects occur three to five hours after being taken. Dryness of the mouth, nausea, restlessnes, dilated pupils are common signs and symptoms. Visual hallucinations, visual	Have the students write a short report on different types of hallucinogens. The students will be evaluated from the quality of the report.

Content	Examples, Apparatus and Material	Activities	Evaluation
		distortions and mood changes may occur similar to LSD.	
4. Stimulants		Tell the students that stimulants affect the central nervous system. For example, coffee, tea, and other beverages. The synthetic stimulants are amphetamine and cocaine.	
a. Amphetamine (common name speed, Bennies, pep pills, ups, dexical, co-pilots, footballs, chrystal)		Amphetamines are white, odourless, water soluble, bitter powder or volatile colorless liquid with strong odour. Amphetamines may be sniffed, taken orally, or injected.	
		Large doses produce fever, heart irregularities, convulsions, or coma. Death may occur by circulatory collapse. It may also produce euphoria, insomnia, loss of weight, compulsion to talk and paranoid behaviour. Death may occur by circulatory collapse.	The students will be evaluated from the report on stimulants.
5. Sedative Barbiturates "goof-balls"		Tell the students that sedatives have a depressant effect on the nervous system. The most commonly abused drug is "Barbiturates" or the street term is "goof-ball" It is available in the form of pills, capsules, and injectible preparations.	
		Incoherency, intoxication, staggering gait, slurred speech, vomiting, drowsiness and depression are most common hazards. In large doses may produce tremors, anxiety, delirium, convulsions, coma, and death.	

Content	Examples, Apparatus and Material	Activities	Evaluation
6. Miscellaneous (Stramonium)		Tell the students that Strammonium is available as a brownish green powder. It is taken by inhaling the smoke of the powder when burned or by swallowing. Dryness of mucus membrane, buring in throat, difficulty in swallowing, skin rash, rapid heart rate, and convulsions are the common signs and symptoms. Activity No. 1 Have students write for literature on drug use and abuse by the World Health Organization, local health unit, and Provincial Department of Health Services. Guest Speaker Invite persons with professional experiences on drug abuse problems and request them to speak on the drug uses and abuses. Invite someone, who has been an addict or has abused drugs. Field Trip Have students compile list of community agencies concerned with drug abuse and	The students will be evaluated

Content	Examples, Apparatus and Material	Activities	Evaluation
		arrange a field trip to the above agencies. Have students collect newspaper clippings magazine articles, on drug abuse. Have students write research papers on such topics as effects of hallucinogens on our general health.	from the number of clippings regarding drug abuse. The students will be evaluated from their written reports on the effects of hallucinogens on our general health.

UNIT VI

Chemistry and Its Applications In Medical Laboratory Technology

I Content

A Importance of Chemistry in the field of Medical Laboratory technology

B Major branches of Medical laboratory technology

C (i) Methods of measuring specific gravity of urine

(ii) Methods of measuring pH

(iii) Methods of testing for protein

(iv) Methods of testing for Glucose

(v) Methods of testing for Ketone

II Objectives

1. To familiarize the students with the applications of Chemistry in the field of medical laboratory technology.

2. To provide an understanding of some of the simple chemical tests of the medical laboratory technology.

III References

Alfred H, Free and Helen M. Free, Urodynamics. Rexdale (Ontario): Ames Company, 1960)

Kark, Lawrence, Pollak, Pirani, Muechrcke and Silva, A Primer of Urinalysis, New York: Harper Row, 1960)

S. Kuppusamy, Chief Medical Technologist, Maple Ridge Hospital, Maple Ridge (B.C.)

Content	Examples, Apparatus and Material	Activities	Evaluation
<u>Problem VI-I</u> What is importance of chemistry in medical laboratory technology?		The teacher should give a brief introductory lecture about the applications of chemistry in Medical laboratory technology. Emphasize that the Medical laboratory is a highly organized and important diagnosic tool in the hands of a doctor. Medical lab technology is gradually becoming a very attractive career for young people. The teacher should explain the five major catagories of Medical laboratory technology (a) Biochemistry (b) Bacteriology (c) Blood Banking (d) Haematology (e) Histology	

Content	Examples, Apparatus and Material	Activities	Evaluation
Problem VI-2 What are major branches of Medical laboratory technology?		Emphasize the importance of chemistry in the above branches of laboratory technology. The teacher may explain the above branches in the following manner. 1. Biochemistry The teacher should define the above concept and emphasize that doctors need to have an idea of the biochemical status of blood and other biological fluids produced by the human body in different diseases. The above information and clinical observations by the doctor of the patient becomes a very efficient diagnostic procedure.	

Content	Examples, Apparatus and Materials	Activities	Evaluation
		Mention that Biochemistry has advanced at a tremendous pace during the last ten years. The move up to date labs are equiped with Autoanalysers that automatically analyse several components of blood at a very raped rate. Some labs are semi-automated and utilize spectrophotometers for analysis. <u>Bacteriology</u> In this branch, disease producing bacteria in different parts ofthe body and body secretions are collected and cultured on suitable media. Effectiveness of particular drugs on these organisms are checked, thus aiding the physicians in his choice of drugs.	

Content	Examples, Apparatus and Materials	Activities	Evaluation
		Blood Banking In an accident where there is loss of blood, the need to transfuse the right group of blood is of utmost importance. Matching donor's blood with the recipients is carried out by the Medical Technologist by making use of several tests. This is one of the most important functions of this department. Haematology Blood counts (i.e. white cell count, red cell count, Platelet count, white cell differential count) and haemoglobin estimation are carried out by the haematology departments. Most laboratories utilize electronic cell counters for counting white cells and red cells. Counts are increased or decreased in different diseases. Blood clotting mechanisms are also investigated.	

Content	Examples, Apparatus and Materials	Activities	Evaluation
		Histology In this branch, tissues and parts of organs that are removed from the body during surgery are investigated for changes in cell structure that conform with particular disease pattern. Biochemistry plays an important role in the major branches of medical Technology. For example, in order to procure blood for analysis, the medical technologist attached to the chemistry department obtains it by means of verri puncture. This is a minor operation of inserting a needle attached to a syringe into a prominent vein in the arm and obtaining a sample. This blood sample is allowed to clot and separate into serum and cells in a test tube.	

Content	Examples, Apparatus and Material	Activities	Evaluation
		The test tube of blood is then centrifuged for about ten minutes where by the serum is cleared of cells. The cells settle to the bottom. The serum is decanted and various techniques employed to analyse the different components present. Apart from blood, spinal fluid and urines are analysed. Urine for example is analysed for proteins, sugars and other by products of metablolism. Checking urine for specific gravity, pH, proteins, Glucose and Ketones are routinely don by technologists in the biochemical department. The above tests can be easily performed in the high school laboratory.	

Content	Examples, Apparatus and Materials	Activities	Evaluation
	Clinical hydrometer Specimen of urine Litmus paper (red and blue) pH paper test tube glass rod	Activity VI-I To Measure the Specific Gravity of Urine Specific gravity of urine in patients with healthy kidneys provides information about the state of hydration of the person. Highly concentrated urine implies dehydration. Normal specific gravity of urine ranges between 1.010 to 1.030. Specific gravity is measured by using a clinical hydrometer. These could be obtained from local biological supplies. They should be checked against water before using on urines. Experiment VI-I Take about 100 ml of urine sample in a graduated cylinder and immerse a clinical hydrometer in the above cylinder. Experiment VI-2 To measure pH of the given sample of urine. (a) Blue and red litmus paper	The students are required to write the observations and specific gravity of a given sample of urine in their lab notebooks.

Content	Examples, Apparatus and Materials	Activities	Evaluation
		Test the sample of urine with the blue and red litmus paper. The above test is too crude to be useful. The change from red (acid) to blue (alkaline urine) occurs in the region of pH 6.5. No rmal urine pH range is 4.5 to 8.0. b) Nitrazine paper This universal indicator has a range from 4.5 to 7.5. The color varies from yellow to blue and can be matched against standards.	
Problem What are the advantages of measuring pH to the physicion?		The teacher should emphasize that control of uninary pH is important in the diagnosis of several diseases especially when giving certain drugs. pH must be measured in fresh urine.. When urine stands, the acidity increases for a short time after voiding but later becomes alkaline as urea is broken down to ammonia.	

Content	Examples, Apparatus and Materials	Activities	Evaluation
		Persistently acid urine occurs in a variety of deseases. Persistently alkaline urine occurs in some infection, metabolic disorders and also as a result of giving certain drugs. Experiment VI-3 Method of testing for Proteins Urine contains small amount of proteins. Persistent proteinurea (protein in urine) may be due to kidney desease. 1. Boiling and Addition of Acetic Acid	
	Filter paper Bunsen Burner Centrifugal machine Test tube Acetic Acid	(a) Filter or centrifuge or heat to 40° to the urine sample till you get a clear urine sample.	

Content	Examples, Apparatus and Materials	Activities	Evaluation
		(b) Take 10-15 ml of urine sample form step (a) in a test tube and boil the upper portion over a flame pointing the test tube away from your face.	
		(c) If the urine becomes cloudy, add 3 drops of concentarated acetic acid and boil again. If the cloudiness persists protein is present. This test is very sensitive.	The students are required to note the obsercation in their note book.
		II Method The teacher should also mention that there are some other tests of measuring proteins such as sufosalicyclic acid test.	
		Experiment VI-4 Testing of Glucose Benedicte Test	The students are required to note the obsercations in their notebook.
	Benedict solution test tube busnsen burner urine sample	To 5ml of Benedict's reagent in a test tube add 8 drops of urine. Mix them well. Place in a boiling water bath at 100 C for exactly five min.	

Content	Examples, Apparatus and Materials	Activities	Evaluatio
		The abouve test is read by grading the color and density of any precipitate which it forms. It is sometimes recorded as a trace to four plus in the color ranges green through yellow to orange to orange red. The teacher may emphasize that test for glycousria (glucose in the urea) are part of the examination of any patients. Diabetes mellitus is a common disease and the best screening method for detecting the presence of sugar is to examine the urine for glucose. However, the absence of glucose in urine does not exclude the diagnosis.	

UNIT VII

SPACE EXPLORATIONS

I Content

A. Solar

B. Apollo Flights

C. Canadian Space Program

II Objectives

1. To familiarize the students with the recent space explorations.
2. To provide an understanding of the Solar system.

III References

Space Resources for Teachers: (Berkeley, California): Lawrence Hall of Science, University of California.

Aerospace Curriculum Resource Guide. (Massachusetts: Department of Education)

Introducing Children to Space , (Lincoln: Nebraska Public Schools

Medical Benefits from Space Research. (Florida: NASA John F. Kennedy Space Centre)

Content	Examples, Apparatus and Material	Activities	Evaluation
What are the various bodies of our solar system and how are these arranged?		Have the students discuss the solar system. Tell the students about the arrangement of various bodies such as, The Sun, planets, satellites, meteors in the solar system. Explain with the help of a diagram the movement of planets around the sun. Ask the students why the sun reamins at the centre of the solar system. Also emphasize the role of astronomers in finding out formation and organization of the solar system. Explain the various steps of a Scientific method. (Refer to Unit I) such as A. Making an accurate survey of the problem B. Setting up the method of attacking the problem C. Collecting data regarding the problem D. Drawing conclusions from the data which have been collected.	
What method does an astronomer employ in finding the formation of the solar system?			
What are the recent innovations in the space programs?	Apollo Mission Films can be obtained from the National Audio Visual Centre (GSA) Washington D.C. 20409	The teacher should provide the historical background of space programs in the United States starting from one man mercury space craft mission to the larger Apollo vehicle carrying	

Content	Examples, Apparatus and Material	Activities	Evaluation
astronauts and		astronauts and a powerful lunar module for the actual lunar landing and return. If possible, Apollo Mission films should be shown. Emphasize that America's imaginative and most challenging space programs seemed to have reached an incredible climax on the Sunday afternoon of July 20, 1969, when Apollo II Lunar excursions module Eagel settled to the surface of the moon in the desolate sea of Tranquility, one year ahead of schedule. Also explain other Apollo flights 11, 13, 14, 15, 16, 17 Emphasize that the Successes of Apollo II and subsequent manned lunar missions were heralded as milestone of technology but still to come were more meaningful achievements capable of bringing rich returns for the benefit of all mankind. <u>Round Table Conference</u> Have the students discuss the implications of the space flights on the mankind. The teacher should point out that what other scientific and technological benefits may expect from space innovations can only be guessed at, but properly directed, this new science will be more than worth the billions of dollars.	The students will be evaluated from their active participation in the class discussion.

Content	Examples, Apparatus and Material	Activities	Evaluation
What do you know about Canadian Space Program?		Emphasize that Canada concentrates her space efforts entirely in the area of satellites that probe the upper atmosphere in the interest of improved communication around the world.	
What is Alouette 1?		Tell the students that Alouette 1 was launched from Vandenburg Air Base. Canada has built three more satellites; Alouette 1 on Nov. 29, 1965, ISIS (International Satellite for Ionspheric Studies) on January 20, 1969; ISIS II on March 31, 1971. Much knowledge has been learnt about the ionosphere from the Canadian space program. Ionosphere extends fifty miles above the earth and is created mainly by the Sun's Ultra violet rays striking air molecules causing them to split into electrically charged ions and electrons. These charged particles form an electrical conductor that is capable of reflecting radio waves. This makes possible radio transmissions over long distancesk on the earth's surfaces. Thus, Canada's satellites may provide the means of conquering communications problems caused by solar disturbances.	

Content	Examples, Apparatus and Material	Activities	Evaluation
What are the advantages of Canadian Space Program?		Tell the students that the police around the world may benefit from Canada's space program. For example, space antenna's were adopted by police in several Canadian and U.S. cities and fixed to the roofs of squad cars to extend high powered emergency beams into the air. Canadian space programs may make possible to have communications to remote and far away communities. Emphasize that no doubt Canadian space program has not received wide international publicity but it is the most important contributions in space programs.	The students will be evaluated from a written report on Canadian space program.

UNIT VIII

CHEMISTRY IS FUN
(Suggested time: 1 week)

I. Content

A. Christmas and Easter demonstrations

B. Role of Chemistry in the national economy of a country

C. Chemical fair

II. Objectives

1. To familiarize the students with interesting chemical demonstrations
2. To bring local community closer to the school
3. To familiarize the community with the applications of chemistry in their daily life

III References

L.H. Sibley, "Christmas Demonstrations", CHEM 13, News, (December, 1972), p. 3-4

H.N. Alyea and F.B. Dutton, Tested Demonstrations in Chemistry (Easton (Pa): Journal of Chemical Education Publication) 1969.

NOTE: The demonstrations suggested are fairly widely used. For more detailed information regarding the above or additional demonstrations, the author highly recommends the above two references.

UNIT VIII - CHEMISTRY IS FUN

Content	Examples, Apparatus and Material	Activities	Evaluation
Problem VIII-A **Christmas Demonstrations** What is Christmas Cake demonstration?	½ cup granulated sugar 50 ml conc. H_2SO_4 1 Beaker (100 ml) 1 Graduated Cylinder (100 ml) 1 large sheet of asbestos at least 1 foot square Goggles or protective glasses	**Demonstration VIII -1** (i) Measure sugar into beaker (ii) Place beaker in middle of asbestos (iii) Slowly pour acid into sugar (iv) Stand back and watch the "cake" rise. **Precautions** (a) Use extreme caution in measuring and pouring acid. (b) Have all students at least 6 feet away from the demonstration table. (c) Allow "cake" to cool at completion of demonstration, and deliver to incinerator with due caution. (d) Use goggles or protective glasses.	
What is Christmas Cracker Deluxe demonstration?	1 ring stand with small ring 1 asbestos sheet 3' x 3' 1 large metal container (such as a roasting pan) 1 graduated cylinder 1 pair of goggles or protective glasses 1 glass stirring rod 10 grams Potassium Permagnate 5 ml glycerine	**Demonstration VIII -2** (i) Place a roaster on the ring stand (ii) Put asbestos sheet on table (iii) Put roaster in the middle. Put cup in ring. (iv) Measure Potassium Permagnate and put in cup (v) Measure glycerine and add to potassium permagnate (vi) Stir briefly with glass rod just until mixed	

Content	Examples, Apparatus and Material	Activities	Evaluation
		(vii) Stand back !! Fire !! Precautions (a) Avoid spilling or touching potassium permanganate - it stains hands and clothes. (b) Keep all students 6 feet away from the demonstration table (c) Have room well ventilated	
What is Vesuvius demonstration?	1 Ring Stand 1 Asbestos gauze square 1 Evaporating dish 1 Bunsen burner Newspaper to cover 3' x3' square Foil to cover the newspaper 1 Pair protective gloves goggles Ammonium Dichromate (15 gms) 1 Evaporating dish	Demonstration VIII -3 (i) Cover table with newspaper and then put foil (ii) Place ring stand assembly in the middle. (iii) Put asbestos gauze on ring (iv) Put measured amount of ammonium dichromate in evaporating dish. Place on asbestos gauze. (v) Light bunsen burner (vi) Put on goggles (vii) Hold burner under gauze - moving it so as to heat all portions (viii) When the action starts, remove burner, turn off gas and stand back to enjoy the show. Precautions Same as in Activity VIII - 2	

Content	Examples, Apparatus and Material	Activities	Evaluation
What is Chafing Dish Special demonstration?	1 Asbestos square 2 Beakers (250 ml) 1 Graduate cylinder (250 ml) 1 Graduated cylinder (25 ml) Saturated calcium Acetate solution (20 ml) 180 ml Methyl alcohol 1 metal spatula	Demonstration VIII -4 (i) Put 20 ml of saturated calcium acetate solution into a beaker (ii) Measure methanol in large cylinder and add to contents of beaker (iii) Pour mixture back and forth from one beaker to the other until a gel is formed. (iv) Place some of the above gel on an asbestos square gauze and ignite. Precautions (a) Don't burn your fingers (b) Keep your hair out of the flame.	
What is Christmas Mobile - From the Kitchen yet demonstration?	2 Tall fat beer glasses Tap water to fill white vinegar 3 tsp. per glass Baking soda 6 moth balls per glass Red food coloring Green food coloring 1 Tablespoon	Demonstration VIII -5 (i) Fill glasses with water (ii) Stir in slowly at least 3 tsp. full vinegar per glass and two tsp. of baking soda (iii) Into the fizzing liquid drop 6 mothballs per glass (iv) Add vegetable dye (v) Balls will sink first then one after another proceed to bounce up and down.	

Content	Examples, Apparatus and Material	Activities	Evaluation
What is Color TV (OLD NASSAU) demonstration?	Preparation - Solution A 16 g potassium iodate in 1000 ml water Solution B 4 g soluble starch - 500 ml boiling water Solution C 3 g mercuric chloride ($Hgcl_2$) in 1000 ml water Ring stand assembly Asbestos gauze Bunsen burner	Demonstration VIII -6 Mix equal amounts of solutions B, C and A in the above order in a 500 ml beaker. Solution first turns bright orange, then blue and black	
What is Blushing Rose demonstration?	½" paint brush 1" paint brush Phenolphthalein solution Ethyl Alcohol (50 ml) 1 Tack board Solution of ammonia 1 sponge Water (50 ml)	Demonstration VIII -7 (i) Before class have an artistic student draw the outline of a rose (about 18"). Mount on tack board. (ii) With appropriate brushes paint the rose with phenolphthalein, alcohol, water mixture. Allow it to dry. (iii) Just before the demonstration dampen the rose lightly. A very fine spray would be good if available. (iv) Have sponge out of sight soaking in ammonia	

Content	Examples, Apparatus and Material	Activities	Evaluation
Note: The writer recommends that the above demonstrations should be done in a micro scale before the class in order to avoid any hazard.		(v) Squeeze out excess and hold near the painted Rose. When the ammonia has evaporated, the blush will disappear.	

Content	Examples, Apparatus and Material	Activities	Evaluation
Problem VIII - B What is the role of chemistry in the national economy of a country?	Charts on national economy of the United States, Canada	Tell the students the role of chemistry in the national economy of U.S. and Canada. Seminar I Ask a social studies teacher to explain the national economy of the U.S. and Canada, emphasizing the name and nature of chemical substances and goods manufactured, imported and exported. After seminar teacher should discuss the development of chemical industry in the U.S. and Canada and the use of its products in agriculture or in local industry	
Problem VIII - C What do you mean by Chemical fair?	The equipment available in laboratory for chemical fair	The teacher should arrange a chemical fair and the community should be invited to attend that fair. Display of chemistry experiments should be made by the students. The demonstrations should be mainly concerned with the applications of chemistry in the community life.	
In the opinion of the writer, the Chemical fair			

Content	Examples, Apparatus and Material	Activities	Evaluation
should be divided into various booths.			
Problem VIII - D			
What is the chemistry building materials?	Cement Lime Plaster Insulating material	Booth I Chemistry in our daily life. The students should exhibit the common chemical substances used in building materials, e.g., cement, lime, plaster.	
Problem VIII - E			
What is balanced diet?	Charts of balanced diet picture of rats or persons eating poor diet	Booth II The students should explain about balanced diet and disadvantages of taking poor diet, with the help of pictures.	
Problem VIII - F			
How to remove spots and stains from the clothes?	organic solvents e.g., benzene, alcohol	Booth III Have the students bring the clothes from the home which have stains of ink, rust, paint and grease. They should remove these spots with the help of organic solvents.	

Content	Examples, Apparatus and Material	Activities	Evaluation
Problem VIII - G How can we manufacture soap?	Sodium hydroxide Vegetable or animal fat, Oil Beaker	Booth IV Have the students prepare a sample of soap by heating animal and vegetable fats or oil in a boiling solution of sodium hydroxide.	
Summary Question What did you learn from this course?		The students are required to review all the units they have discussed before and a discussion type exam would be taken to find out how much they can apply the knowledge of chemistry in their daily life.	The students will be evaluated for the final grade from the active participation in the class discussions. The students should be given a written exam which should be mainly concerned with applications of chemistry in their daily life.

PART III

SUGGESTED EVALUATION PROCEDURE FOR TURN ON CHEMISTRY PROGRAM [1, 2]

Our present system of grade placement of students, although based to an extent on the idea of maturation level, in effect hinders the application of what might be learned from research. Chronological age and mental age do not always correspond and thus many students who are taught in the same class by the same methods and using the same instructional material are neither ready to understand the material nor are they ready to advance to more complex forms of learning. In essence, they are prevented from doing so by their grade placement. The problem of evaluating of non chemistry major, low achievers, native Indian students and Afro-American students is even more complicated because they are generally not interested in the material offered in the present science course, usually results in failure and frustrations. Satisfacti[illegible]ill come from success, and success will result when interest is aroused.

In order to give the feeling of success to these students, we have to change the present system of evaluation. Instead of giving a D or E for poor achievement to these students, the science teacher should give extra help or time and design evaluation to help them attain more sub-goals which lead to mastery. This method of individualization incorporates the following concept of evaluation which the author has found quite successful in his science classes, especially with the native Indian students and low achievers.

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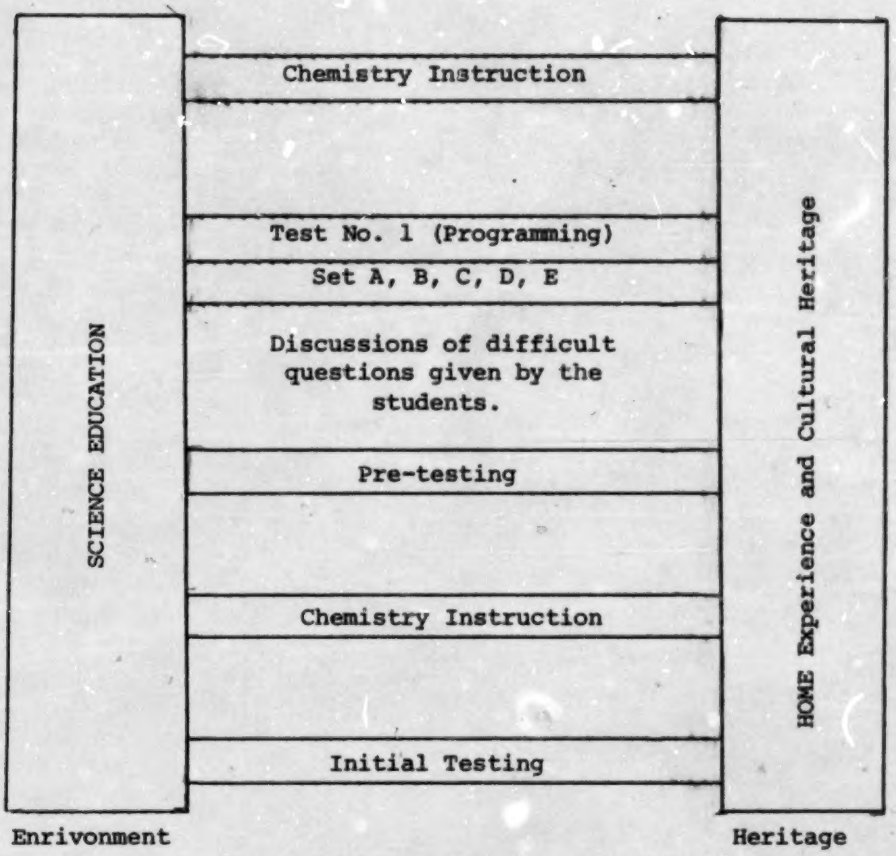
[1] R.M. Kalra, Innovations in Teaching, Hilroy Fellowship Project (1970-71) Ottawa: Canadian Teachers' Federation.

[2] R.M. Kalra and M.H. Bruce, "Evaluation and Examination in Science Education in India", Journal of Indian Educational Review, July, 1973.



FINAL GOAL:

To achieve success and learn the desired concept

Schematic Representation of an Evaluation which recognizes the different Cultural Background and degree of science proficiency especially in Chemistry

The evaluation procedure suggested above is comprised of the following steps.

STEP I - Initial Testing

The tests are designed to find out the previous level of achievement in science. If a science teacher is aware of the previous science background of these students, he would be able to develop an individualized program of studies designed to correct deficiencies and satisfy needs according to the ability of the student.

STEP II - Chemistry Instructions

There are few methods of teaching science. Methods (like the Historical Method, the Lecture Method, the Heuristic Method, Normal Experimental Method, the Project Method and the Unit Problem Method) have from time to time been suggested, but have never been formulated into definite schemes.

The following brief outline gives an idea of suggested procedure for Chemistry teaching to these students.

(a) Announce a day early, the subject matter to be studied.

(b) Give the historical aspect of the subject matter under study. Try to introduce the concept in Chemistry with reference to various cultures such as native Indian and Afro-American students in order to develop pride in the competence of their scientific achievements.

(c) In a selected unit of Chemistry which can be studied experimentally, help the students in interpreting the experimental facts.

(d) Chemical fairs should be arranged and the native Indian and other cultural scientific achievements should be displayed. Native Indian students' participation in these fairs should be voluntary but encouragement to any student is often required. The projects in the fairs must supplement the teaching of science.

(e) Incorporatedinto the Chemistry curriculum should be native Indian scientific knowledge that existed before the coming of white man.

STEP III

After imparting instructions on certain scientific concepts, for example, Mole concept, the Chemistry teacher should have a "Pre-Test". The purpose of this test is to find out the concepts which have not been properly understood by the students. Furthermore, the students are asked to hand in questions for discussions and for use in quizzes. The student may use any format they wish - objective type, semi-objective, fill in the blanks or programmed

type. These questions and the students' participation in these discussions are also considered a part of the evaluation.

STEP IV

The next step is Exam A. The exam consists of quizzes based on programmed as well as semi-objective type questions. The students will be asked to take a quiz on each of the science units or textbook chapters as they occur.

In order to take quizzes on subsequent chapters or units, the students must pass the quiz on the preceding chapter or unit. Passing is 50% and the students may take each quiz as many times as is necessary to pass it. However, as an incentive, liberal time limits for the passing of these units should be set by the teacher.

The evaluation procedure suggested above allows the students to proceed at their own rate which is compatible with the native Indian philosophy of time and the completion of task.

The method of evaluation suggested above also takes into consideration the fact that some of the brilliant students may complete the exam in less than prescribed time. To satisfy the fast learners, the Science teacher should give some extra difficult assignments or quizzes for these students and an extra credit (C+, B or A) should be given for this extra effort.

The author got very encouraging results by implementing the above evaluation procedure. Students' progress and interest in the subject was quite evident.

APPENDIX I

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A. Books

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APPENDIX II

Directory of Distributors of Science Education Material

Most of the American companies and institutions listed below distribute on request, useful free material. Some charge a small sum of a dollar or so.

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2. Central Scientific Company, 1700 N. Irving Park Road, Chicago 13.
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5. Manufacturing Chemists' Association, Inc., 1625 Eye Street, North West Washington 6, D.C.
6. Westinghouse Electric Corporation, 401 Liberty Avenue, Box 2278, Pittsburg 30, Pa.
7. Reference Aid
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8. General Motors Aids to Educators, General Motor Corporation, Detroit, Michigan
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